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ASTRONOMICAL PHENOMENA

FOR THE YEAR

2010

Prepared Jointly by

The Nautical Almanac Office

United States Naval Observatory

and

Her Majesty's Nautical Almanac Office

United Kingdom Hydrographic Office

WASHINGTON

U.S. Government Printing Office

2007

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ASTRONOMICAL PHENOMENA

FOR THE YEAR 2010

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The astronomical data in this booklet are expressed in the scale of universal time (UT); this is also known as Greenwich mean time (GMT) and is the standard time of the Greenwich meridian (0° of longitude). A time in UT may be converted to local mean time by the addition of east longitude (or subtraction of west longitude), where the longitude of the place is expressed in time-measure at the rate of 1 hour for every 15°. The differences between standard times and UT are indicated in the chart on page 22; local clock times may, however, differ from these standard times, especially in summer when clocks are often advanced by 1 hour.

PRINCIPAL PHENOMENA OF SUN AND MOON, 2010

THE SUN

Perigee	...	Jan.	d h	Equinoxes	...	Mar.	d h m	...	Sept.	d h m
Apogee	...	July	6 11	Solstices	...	June	21 11 28	...	Dec.	21 23 38

PHASES OF THE MOON

Lunation	New Moon			First Quarter			Full Moon			Last Quarter		
	d	h	m	d	h	m	d	h	m	d	h	m
1076										Jan.	7	10 39
1077	Jan.	15	07 11	Jan.	23	10 53	Jan.	30	06 18	Feb.	5	23 48
1078	Feb.	14	02 51	Feb.	22	00 42	Feb.	28	16 38	Mar.	7	15 42
1079	Mar.	15	21 01	Mar.	23	11 00	Mar.	30	02 25	Apr.	6	09 37
1080	Apr.	14	12 29	Apr.	21	18 20	Apr.	28	12 18	May	6	04 15
1081	May	14	01 04	May	20	23 43	May	27	23 07	June	4	22 13
1082	June	12	11 15	June	19	04 29	June	26	11 30	July	4	14 35
1083	July	11	19 40	July	18	10 11	July	26	01 37	Aug.	3	04 59
1084	Aug.	10	03 08	Aug.	16	18 14	Aug.	24	17 05	Sept.	1	17 22
1085	Sept.	8	10 30	Sept.	15	05 50	Sept.	23	09 17	Oct.	1	03 52
1086	Oct.	7	18 44	Oct.	14	21 27	Oct.	23	01 37	Oct.	30	12 46
1087	Nov.	6	04 52	Nov.	13	16 39	Nov.	21	17 27	Nov.	28	20 36
1088	Dec.	5	17 36	Dec.	13	13 59	Dec.	21	08 13	Dec.	28	04 18

ECLIPSE

An annular eclipse of the Sun	Jan. 15	Southern tip of Chad, the Central African Republic, the northern Democratic Republic of Congo, Uganda, Kenya, the southern tip of Somalia, the Indian Ocean, the southern tip of India, northern Sri Lanka, the south-eastern tip of Bangladesh, Myanmar and south-eastern China.
A partial eclipse of the Moon	June 26	Parts of the Americas, the Pacific Ocean, Antarctica, eastern Asia and Australasia.
A total eclipse of the Sun	July 11	The Cook Islands, French Polynesia, the south-eastern Pacific Ocean and the southernmost parts of Chile and Argentina.
A total eclipse of the Moon	Dec. 21	Europe, west Africa, the Americas, the Pacific Ocean, eastern Australia, the Philippines and eastern and northern Asia.

MOON AT PERIGEE

	d	h		d	h		d	h
Jan.	1	21	May	20	09	Oct.	6	14
Jan.	30	09	June	15	15	Nov.	3	17
Feb.	27	22	July	13	11	Nov.	30	19
Mar.	28	05	Aug.	10	18	Dec.	25	12
Apr.	24	21	Sept.	8	04			

MOON AT APOGEE

	d	h		d	h		d	h
Jan.	17	02	June	3	17	Oct.	18	18
Feb.	13	02	July	1	10	Nov.	15	12
Mar.	12	10	July	29	00	Dec.	13	09
Apr.	9	03	Aug.	25	06			
May	6	22	Sept.	21	08			

OCCULTATIONS OF PLANETS AND BRIGHT STARS BY THE MOON

Date	Body	Areas of Visibility
d	h	
Jan 11 13	<i>Antares</i>	N.E. United States, E. Canada, S. tip of Greenland
Feb 7 19	<i>Antares</i>	Aleutian Islands, S.W. Alaska, Bering Sea
May 16 10	Venus	Northern half of Africa, Turkey, Middle East, India, southern China, S.E. Asia, Indonesia
May 29 22	Ceres	Southern Africa, Madagascar, Indian Ocean, S.E. Asia, Indonesia
June 25 19	Ceres	Eastern Europe, most of the Middle East, Central Asia, N. India, N.W. China, Mongolia
Sept 11 13	Venus	Eastern Brazil, south Atlantic Ocean, S.W. Africa, S. Indian Ocean
Nov 2 00	Juno	Most of Russia, N. China, Mongolia, Japan, Marshall Islands
Nov 29 23	Juno	Indian Ocean, S. tip of India, Sri Lanka, W. Indonesia, southern and western Australia, New Zealand

Maps showing the areas of visibility may be found on ^{WWW} AsA-Online.

GEOCENTRIC PHENOMENA

MERCURY

	d	h		d	h		d	h		d	h
Inferior conjunction ...	Jan.	4 19		Apr.	28 17		Sept.	3 13		Dec.	20 01
Stationary	Jan.	15 16		May	11 00		Sept.	12 03		Dec.	30 08
Greatest elongation West	Jan.	27 06 (25°)		May	26 02 (25°)		Sept.	19 18 (18°)		—	
Superior conjunction ...	Mar.	14 13		June	28 12		Oct.	17 01		—	
Greatest elongation East	Apr.	8 23 (19°)		Aug.	7 01 (27°)		Dec.	1 15 (21°)		—	
Stationary	Apr.	18 10		Aug.	20 04		Dec.	10 10		—	

VENUS

	d	h		d	h
Superior conjunction ...	Jan.	11 21	Inferior conjunction ...	Oct.	29 01
Greatest elongation East	Aug.	20 04 (46°)	Stationary	Nov.	16 16
Greatest illuminated extent	Sept.	23 20	Greatest illuminated extent	Dec.	4 10
Stationary	Oct.	7 19			

EARTH

	d	h		d	h	m		d	h	m
Perihelion ...	Jan.	3 00	Equinoxes ...	Mar.	20 17 32		Sept.	23 03 09		
Aphelion ...	July	6 11	Solstices ...	June	21 11 28		Dec.	21 23 38		

SUPERIOR PLANETS & PLUTO

	Conjunction		Stationary		Opposition		Stationary	
		d h		d h		d h		d h
Mars	...	—		—	Jan.	29 20	Mar.	11 09
Jupiter	...	Feb. 28 11	July	24 04	Sept.	21 12	Nov.	19 06
Saturn	...	Oct. 1 01	Jan.	14 19	Mar.	22 01	May	31 16
Uranus	...	Mar. 17 07	July	6 01	Sept.	21 17	Dec.	6 10
Neptune	...	Feb. 14 23	June	1 02	Aug.	20 10	Nov.	7 08
Pluto	...	Dec. 27 01	Apr.	7 01	June	25 19	Sept.	14 01

The vertical bars indicate where the dates for the planet are not in chronological order.

HELIOCENTRIC PHENOMENA

	Aphelion	Perihelion	Descending Node	Greatest Lat. South	Ascending Node	Greatest Lat. North
Mercury	Feb. 13	Mar. 29	Feb. 3	Mar. 5	Mar. 24	Jan. 10
	May 12	June 25	May 2	June 1	June 20	Apr. 8
	Aug. 8	Sept. 21	July 29	Aug. 28	Sept. 16	July 5
	Nov. 4	Dec. 18	Oct. 25	Nov. 24	Dec. 13	Oct. 1
	—	—	—	—	—	Dec. 28
Venus	Jan. 24	May 16	—	Feb. 15	Apr. 13	June 7
	Sept. 6	Dec. 27	Aug. 2	Sept. 28	Nov. 23	—
Mars	Mar. 30	—	Sept. 6	—	—	Feb. 21

Jupiter, Saturn, Uranus, Neptune, Pluto: None in 2010

VISIBILITY OF PLANETS

MERCURY can only be seen low in the east before sunrise, or low in the west after sunset (about the time of beginning or end of civil twilight). It is visible in the mornings between the following approximate dates: January 11 to March 4, May 8 to June 21, September 11 to October 5 and December 26 to December 31. The planet is brighter at the end of each period, (the best conditions in northern latitudes occur in the second half of January and in the second half of September and in southern latitudes from mid-May to early June). It is visible in the evenings between the following approximate dates: March 24 to April 20, July 6 to August 27 and November 1 to December 14. The planet is brighter at the beginning of each period, (the best conditions in northern latitudes occur in the first half of April and in southern latitudes from late July to mid-August).

VENUS is too close to the Sun for observation until late February when it appears as a brilliant object in the evening sky. In the last week of October it again becomes too close to the Sun for observation until early November when it reappears in the morning sky. Venus is in conjunction with Mars on August 23 and September 29 and with Saturn on August 10.

MARS rises well after sunset at the beginning of the year in Leo and passes into Cancer in the second week of January. It is at opposition on January 29, when it is visible throughout the night. Its eastward elongation gradually decreases and from mid-May it is visible only in the evening sky in Leo (passing $0^{\circ}9'N$ of *Regulus* on June 6), Virgo (passing $2^{\circ}N$ of *Spica* on September 4), Libra, Scorpius and Ophiucus (passing $4^{\circ}N$ of *Antares* on November 10). It then continues into Sagittarius in early December after which it becomes too close to the Sun for observation. Mars is in conjunction with Saturn on August 1, with Venus on August 23 and September 29 and with Mercury on November 21 and December 14.

JUPITER can be seen in the evening sky in Capricornus passing into Aquarius during the first week of January. It becomes too close to the Sun for observation after mid-February and reappears in the morning sky during mid-March. Its westward elongation gradually increases, moving into Pisces in early May and from late June it can be seen for more than half the night. Jupiter is at opposition on September 21 when it is visible throughout the night. Its eastward elongation then gradually decreases, passing into Aquarius in mid-October and then into Pisces in mid-December when it can only be seen in the evening sky.

SATURN rises shortly before midnight at the beginning of the year in Virgo and remains in this constellation throughout the year. It is at opposition on March 22 when it is visible throughout the night. From late June until mid-September Saturn is visible only in the evening sky, and then becomes too close to the Sun for observation. It can be seen only in the morning sky from mid-October until the end of the year. Saturn is in conjunction with Mars on August 1 and with Venus on August 10.

URANUS is visible at the beginning of the year in the evening sky in Aquarius, passes into Pisces in mid-January and remains in this constellation throughout the year. From late February it becomes too close to the Sun for observation and reappears in early April in the morning sky. Uranus is at opposition on September 21. Its eastward elongation gradually decreases and from mid-December it can only be seen in the evening sky.

NEPTUNE is visible at the beginning of the year in the evening sky in Capricornus. In late January it becomes too close to the Sun for observation and reappears in early March in the morning sky. It moves into Aquarius during the second half of March, passes into Capricornus in mid-August and remains in this constellation for the rest of the year. Neptune is at opposition on August 20 and from mid-November can be seen only in the evening sky.

DO NOT CONFUSE (1) Venus with Mercury from late March to mid-April, with Saturn in the first half of August and with Mars from early August to early September; on all occasions Venus is the brighter object. (2) Mars with Saturn from late July to early August when Saturn is the brighter object. (3) Mercury with Mars in the second half of November when Mercury is the brighter object.

VISIBILITY OF PLANETS IN MORNING AND EVENING TWILIGHT

	Morning	Evening
Venus	November 4 – December 31	February 23 – October 24
Mars	January 1 – January 29	January 29 – December 5
Jupiter	March 14 – September 21	January 1 – February 15 September 21 – December 31
Saturn	January 1 – March 22 October 19 – December 31	March 22 – September 13

VISIBILITY OF PLANETS

The planet diagram on page 9 shows, in graphical form for any date during the year, the local mean times of meridian passage of the Sun, of the five planets, Mercury, Venus, Mars, Jupiter and Saturn, and of every 2^h of right ascension. Intermediate lines, corresponding to particular stars, may be drawn in by the user if desired. The diagram is intended to provide a general picture of the availability of planets and stars for observation during the year.

On each side of the line marking the time of meridian passage of the Sun, a band 45^m wide is shaded to indicate that planets and most stars crossing the meridian within 45^m of the Sun are generally too close to the Sun for observation.

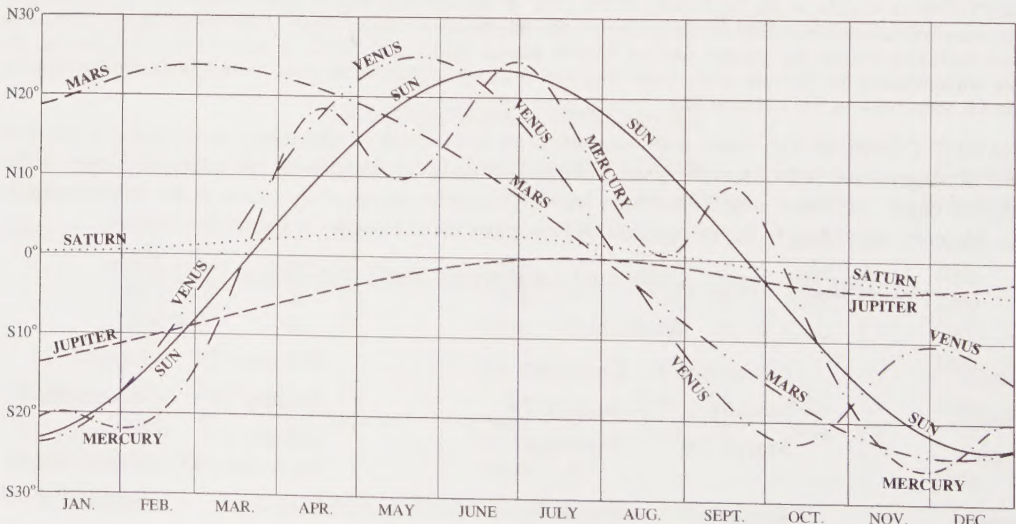
For any date the diagram provides immediately the local mean time of meridian passage of the Sun, planets and stars, and thus the following information:

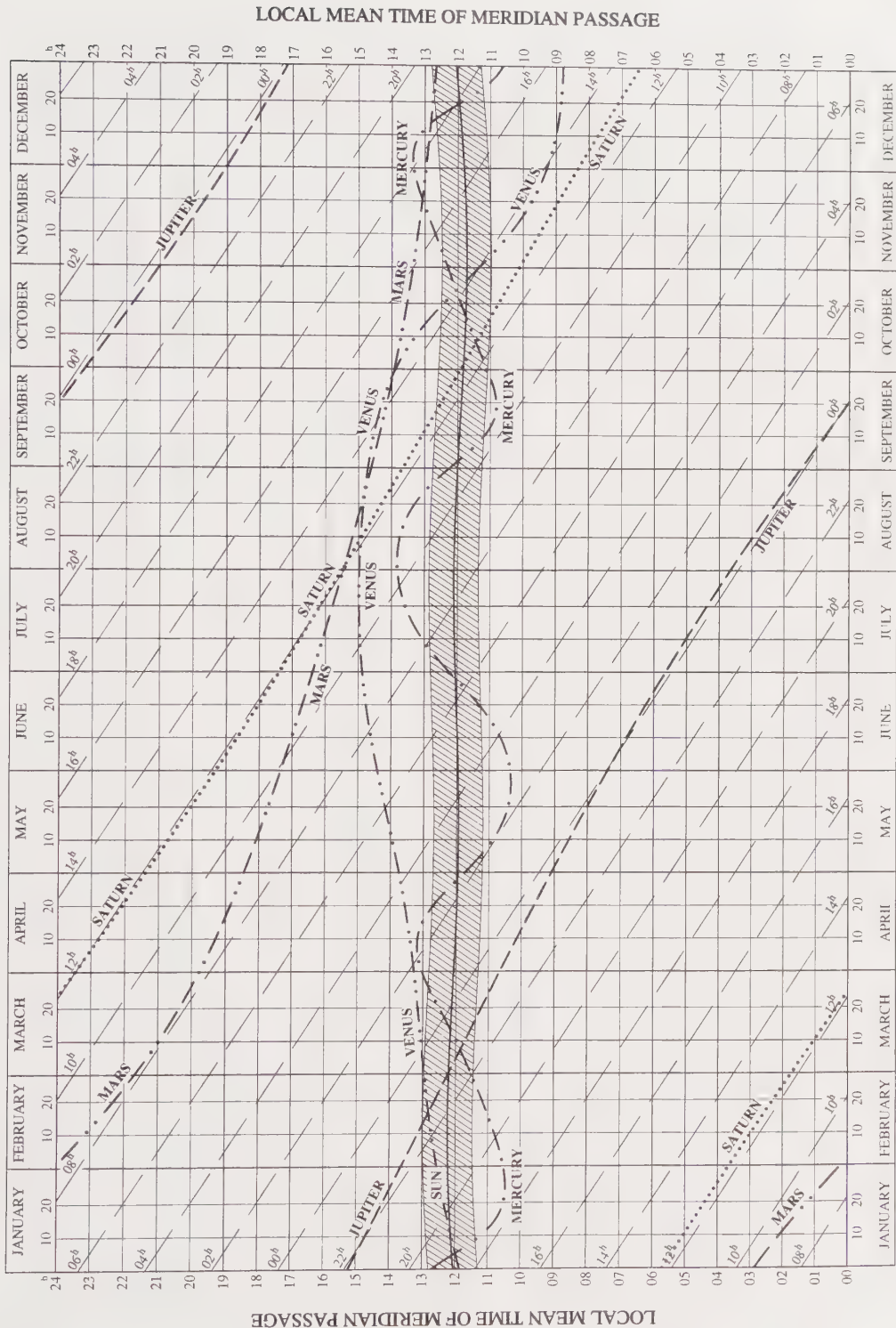
- a) whether a planet or star is too close to the Sun for observation;
- b) visibility of a planet or star in the morning or evening;
- c) location of a planet or star during twilight;
- d) proximity of planets to stars or other planets.

When the meridian passage of a body occurs at midnight, it is close to opposition to the Sun and is visible all night, and may be observed in both morning and evening twilights. As the time of meridian passage decreases, the body ceases to be observable in the morning, but its altitude above the eastern horizon during evening twilight gradually increases until it is on the meridian at evening twilight. From then onwards the body is observable above the western horizon, its altitude at evening twilight gradually decreasing, until it becomes too close to the Sun for observation. When it again becomes visible, it is seen in the morning twilight, low in the east. Its altitude at morning twilight gradually increases until meridian passage occurs at the time of morning twilight, then as the time of meridian passage decreases to 0^h, the body is observable in the west in the morning twilight with a gradually decreasing altitude, until it once again reaches opposition.

Notes on the visibility of the planets are given on page 7. Further information on the visibility of planets may be obtained from the diagram below which shows, in graphical form for any date during the year, the declinations of the bodies plotted on the planet diagram on page 9.

DECLINATION OF SUN AND PLANETS, 2010





ELONGATIONS AND MAGNITUDES OF PLANETS AT 0^h UT

Mercury					Venus					Mercury					Venus				
Date		Elong.			Mag.			Elong.			Mag.			Elong.			Mag.		
Jan.	−1	E.	12	+	1.6	W.	3	−	4.0	July	3	E.	6	−	1.7	E.	41	−	4.1
	4	E.	3	.	.	W.	2	.	.		8	E.	11	−	1.1	E.	41	−	4.1
	9	W.	10	+	2.7	W.	1	.	.		13	E.	16	−	0.7	E.	42	−	4.1
	14	W.	18	+	0.7	E.	1	.	.		18	E.	20	−	0.4	E.	43	−	4.2
	19	W.	23	0	0.0	E.	2	.	.		23	E.	23	−	0.2	E.	44	−	4.2
Feb.	24	W.	24	−	0.2	E.	3	−	4.0	Aug.	28	E.	25	0	0.0	E.	44	−	4.2
	29	W.	25	−	0.2	E.	4	−	3.9		2	E.	27	+	0.1	E.	45	−	4.3
	3	W.	24	−	0.2	E.	5	−	3.9		7	E.	27	+	0.3	E.	45	−	4.3
	8	W.	22	−	0.2	E.	7	−	3.9		12	E.	27	+	0.5	E.	46	−	4.4
	13	W.	20	−	0.2	E.	8	−	3.9		17	E.	25	+	0.8	E.	46	−	4.4
Mar.	18	W.	18	−	0.3	E.	9	−	3.9	Sept.	22	E.	21	+	1.4	E.	46	−	4.5
	23	W.	15	−	0.4	E.	10	−	3.9		27	E.	14	+	2.6	E.	46	−	4.5
	28	W.	12	−	0.6	E.	11	−	3.9		1	E.	6	+	4.6	E.	45	−	4.6
	5	W.	9	−	1.0	E.	13	−	3.9		6	W.	6	+	4.7	E.	45	−	4.6
	10	W.	5	−	1.4	E.	14	−	3.9		11	W.	13	+	2.0	E.	44	−	4.7
Apr.	15	E.	2	−	2.0	E.	15	−	3.9	Oct.	16	W.	17	+	0.2	E.	42	−	4.7
	20	E.	5	−	1.7	E.	16	−	3.9		21	W.	18	−	0.6	E.	41	−	4.8
	25	E.	10	−	1.4	E.	17	−	3.9		26	W.	16	−	1.0	E.	38	−	4.8
	30	E.	15	−	1.1	E.	19	−	3.9		1	W.	12	−	1.1	E.	35	−	4.8
	4	E.	18	−	0.7	E.	20	−	3.9		6	W.	9	−	1.2	E.	31	−	4.7
May	9	E.	19	−	0.1	E.	21	−	3.9	Nov.	11	W.	5	−	1.4	E.	26	−	4.6
	14	E.	18	+	0.9	E.	22	−	3.9		16	W.	1	−	1.6	E.	21	−	4.5
	19	E.	14	+	2.4	E.	24	−	3.9		21	E.	3	−	1.3	E.	14	−	4.3
	24	E.	8	+	4.4	E.	25	−	3.9		26	E.	6	−	1.0	E.	8	−	4.3
	29	W.	1	.	.	E.	26	−	3.9		31	E.	9	−	0.7	W.	6	.	.
June	4	W.	8	+	4.4	E.	27	−	3.9	Dec.	5	E.	12	−	0.5	W.	12	−	4.2
	9	W.	15	+	2.8	E.	28	−	3.9		10	E.	14	−	0.4	W.	18	−	4.5
	14	W.	20	+	1.7	E.	30	−	3.9		15	E.	17	−	0.4	W.	25	−	4.6
	19	W.	24	+	1.0	E.	31	−	3.9		20	E.	19	−	0.4	W.	30	−	4.8
	24	W.	25	+	0.6	E.	32	−	3.9		25	E.	20	−	0.4	W.	34	−	4.8
July	29	W.	25	+	0.2	E.	33	−	3.9	Dec.	30	E.	21	−	0.5	W.	38	−	4.9
	3	W.	23	−	0.1	E.	34	−	3.9		5	E.	21	−	0.4	W.	40	−	4.9
	8	W.	21	−	0.4	E.	35	−	4.0		10	E.	18	+	0.2	W.	43	−	4.8
	13	W.	17	−	0.7	E.	37	−	4.0		15	E.	11	+	2.0	W.	44	−	4.8
	18	W.	12	−	1.1	E.	38	−	4.0		20	E.	2	.	.	W.	45	−	4.8
July	23	W.	7	−	1.7	E.	39	−	4.0	Dec.	25	W.	11	+	2.1	W.	46	−	4.7
	28	W.	1	−	2.3	E.	40	−	4.0		30	W.	19	+	0.4	W.	47	−	4.7
	3	E.	6	−	1.7	E.	41	−	4.1		35	W.	22	−	0.2	W.	47	−	4.6

MINOR PLANETS

		Stationary		Opposition		Stationary		Conjunction	
Ceres	... ..	Apr.	29	June	18	Aug.	9	—	
Pallas	... ..	Mar.	25	May	4	July	3	Dec.	22
Juno	... ..	—		—		—		July	9
Vesta	... ..	Jan.	7	Feb.	18	Apr.	7	Nov.	10

ELONGATIONS AND MAGNITUDES OF PLANETS AND PLUTO AT 0^h UT

Date		Mars		Jupiter		Saturn		Uranus	Neptune	Pluto
		Elong.	Mag.	Elong.	Mag.	Elong.	Mag.	Elong.	Elong.	Elong.
Jan.	−6	W. 134	−0.6	E. 52	−2.1	W. 89	+0.9	E. 80	E. 51	W. 5
	4	W. 145	−0.8	E. 43	−2.1	W. 99	+0.9	E. 70	E. 41	W. 11
	14	W. 158	−1.1	E. 35	−2.1	W. 109	+0.8	E. 60	E. 31	W. 21
	24	W. 171	−1.2	E. 27	−2.0	W. 119	+0.8	E. 50	E. 21	W. 30
Feb.	3	E. 173	−1.2	E. 20	−2.0	W. 130	+0.7	E. 40	E. 12	W. 40
	13	E. 160	−1.0	E. 12	−2.0	W. 140	+0.7	E. 31	E. 2	W. 50
Mar.	23	E. 147	−0.8	E. 4	−2.0	W. 151	+0.6	E. 21	W. 8	W. 59
	5	E. 136	−0.5	W. 4	−2.0	W. 162	+0.6	E. 12	W. 17	W. 69
	15	E. 126	−0.2	W. 11	−2.0	W. 172	+0.5	E. 2	W. 27	W. 79
	25	E. 117	0.0	W. 19	−2.0	E. 176	+0.5	W. 7	W. 37	W. 89
	4	E. 109	+0.2	W. 26	−2.0	E. 166	+0.6	W. 17	W. 46	W. 99
Apr.	14	E. 102	+0.4	W. 34	−2.1	E. 155	+0.7	W. 26	W. 56	W. 108
	24	E. 96	+0.6	W. 41	−2.1	E. 145	+0.8	W. 35	W. 65	W. 118
	May	4	E. 90	+0.8	W. 49	−2.1	E. 135	+0.8	W. 44	W. 75	W. 128
14		E. 85	+0.9	W. 57	−2.2	E. 125	+0.9	W. 54	W. 84	W. 138
June	24	E. 80	+1.0	W. 65	−2.2	E. 115	+1.0	W. 63	W. 94	W. 147
	3	E. 75	+1.1	W. 73	−2.3	E. 105	+1.0	W. 72	W. 104	W. 157
	13	E. 71	+1.2	W. 81	−2.4	E. 96	+1.1	W. 82	W. 113	W. 166
	23	E. 67	+1.3	W. 90	−2.4	E. 87	+1.1	W. 91	W. 123	W. 174
July	3	E. 63	+1.4	W. 98	−2.5	E. 78	+1.1	W. 100	W. 133	E. 171
	13	E. 59	+1.4	W. 107	−2.6	E. 69	+1.1	W. 110	W. 142	E. 162
Aug.	23	E. 56	+1.5	W. 117	−2.6	E. 60	+1.1	W. 120	W. 152	E. 153
	2	E. 52	+1.5	W. 126	−2.7	E. 51	+1.1	W. 129	W. 162	E. 143
	12	E. 49	+1.5	W. 136	−2.8	E. 43	+1.1	W. 139	W. 172	E. 134
	22	E. 46	+1.5	W. 147	−2.8	E. 34	+1.1	W. 149	E. 178	E. 124
	1	E. 42	+1.5	W. 157	−2.9	E. 26	+1.0	W. 159	E. 169	E. 114
Sept.	11	E. 39	+1.5	W. 168	−2.9	E. 17	+1.0	W. 169	E. 159	E. 105
	21	E. 36	+1.5	W. 178	−2.9	E. 9	+0.9	W. 179	E. 149	E. 95
	Oct.	1	E. 33	+1.5	E. 169	−2.9	E. 2	+0.9	E. 170	E. 139	E. 85
11		E. 30	+1.5	E. 158	−2.9	W. 9	+0.9	E. 160	E. 129	E. 75
Nov.	21	E. 27	+1.5	E. 147	−2.8	W. 17	+0.9	E. 150	E. 119	E. 66
	31	E. 24	+1.4	E. 137	−2.8	W. 26	+0.9	E. 140	E. 108	E. 56
	10	E. 22	+1.4	E. 126	−2.7	W. 35	+0.9	E. 129	E. 98	E. 46
	20	E. 19	+1.4	E. 116	−2.6	W. 44	+0.9	E. 119	E. 88	E. 37
	30	E. 16	+1.3	E. 106	−2.6	W. 53	+0.9	E. 109	E. 78	E. 27
	10	E. 14	+1.3	E. 96	−2.5	W. 63	+0.9	E. 99	E. 68	E. 17
Dec.	20	E. 11	+1.3	E. 87	−2.4	W. 72	+0.8	E. 89	E. 58	E. 8
	30	E. 9	+1.2	E. 78	−2.4	W. 82	+0.8	E. 79	E. 49	W. 5
	40	E. 6	+1.2	E. 69	−2.3	W. 91	+0.8	E. 69	E. 39	W. 14

Magnitudes at opposition: Uranus 5.7 Neptune 7.8 Pluto 14.0

VISUAL MAGNITUDES OF MINOR PLANETS

	Jan. 4	Feb. 13	Mar. 25	May 4	June 13	July 23	Sept. 1	Oct. 11	Nov. 20	Dec. 30
Ceres	9.0	8.9	8.6	8.1	7.2	7.9	8.7	9.1	9.3	9.1
Pallas	9.4	9.2	8.8	8.7	9.2	9.7	10.1	10.3	10.3	10.3
Juno	9.3	9.6	9.7	9.8	9.7	9.8	10.1	10.3	10.3	10.0
Vesta	7.1	6.2	6.7	7.4	7.8	8.0	8.0	7.8	7.6	7.8

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h			d	h		
Jan.	1	21	Moon at perigee		Mar.	22	01	Saturn at opposition
	3	00	Earth at perihelion			23	11	FIRST QUARTER
	3	12	Mars 7° N. of Moon			25	03	Pallas stationary
	4	19	Mercury in inferior conjunction			25	14	Mars 5° N. of Moon
	6	19	Saturn 8° N. of Moon			28	05	Moon at perigee
	7	11	LAST QUARTER			29	18	Saturn 8° N. of Moon
	7	21	Vesta stationary			30	02	FULL MOON
	11	13	Antares 1°1 S. of Moon	Occn.	Apr.	6	10	LAST QUARTER
	11	21	Venus in superior conjunction			7	01	Pluto stationary
	13	16	Mercury 5° N. of Moon			7	18	Vesta stationary
	14	19	Saturn stationary			8	23	Mercury greatest elong. E. (19°)
	15	07	NEW MOON	Eclipse		9	03	Moon at apogee
	15	16	Mercury stationary			10	01	Neptune 4° S. of Moon
	17	02	Moon at apogee			11	22	Jupiter 6° S. of Moon
	17	23	Neptune 4° S. of Moon			12	14	Uranus 6° S. of Moon
	18	10	Jupiter 5° S. of Moon			14	12	NEW MOON
	20	11	Uranus 6° S. of Moon			15	23	Mercury 1°5 S. of Moon
	23	11	FIRST QUARTER			16	13	Venus 4° S. of Moon
	27	06	Mercury greatest elong. W. (25°)			18	10	Mercury stationary
	27	19	Mars closest approach			21	18	FIRST QUARTER
	29	20	Mars at opposition			22	09	Mars 5° N. of Moon
	30	06	FULL MOON			24	21	Moon at perigee
	30	08	Mars 7° N. of Moon			26	00	Saturn 8° N. of Moon
	30	09	Moon at perigee			28	12	FULL MOON
Feb.	3	02	Saturn 8° N. of Moon			28	17	Mercury in inferior conjunction
	6	00	LAST QUARTER			29	05	Ceres stationary
	7	19	Antares 1°1 S. of Moon	Occn.	May	4	04	Pallas at opposition
	12	06	Mercury 2° S. of Moon			4	04	Venus 6° N. of Aldebaran
	13	02	Moon at apogee			6	04	LAST QUARTER
	14	03	NEW MOON			6	22	Moon at apogee
	14	23	Neptune in conjunction with Sun			7	10	Neptune 4° S. of Moon
	16	19	Uranus 6° S. of Moon			9	18	Jupiter 7° S. of Moon
	18	06	Vesta at opposition			10	01	Uranus 6° S. of Moon
	22	01	FIRST QUARTER			11	00	Mercury stationary
	26	05	Mars 5° N. of Moon			12	17	Mercury 8° S. of Moon
	27	22	Moon at perigee			14	01	NEW MOON
	28	11	Jupiter in conjunction with Sun			16	10	Venus 0°09 S. of Moon
	28	17	FULL MOON			20	09	Moon at perigee
Mar.	2	10	Saturn 8° N. of Moon			20	12	Mars 5° N. of Moon
	7	16	LAST QUARTER			21	00	FIRST QUARTER
	11	09	Mars stationary			23	05	Saturn 8° N. of Moon
	12	10	Moon at apogee			26	02	Mercury greatest elong. W. (25°)
	13	16	Neptune 4° S. of Moon			27	23	FULL MOON
	14	13	Mercury in superior conjunction			29	22	Ceres 0°09 N. of Moon
	15	21	NEW MOON			31	16	Saturn stationary
	17	07	Uranus in conjunction with Sun		June	1	02	Neptune stationary
	17	12	Venus 7° S. of Moon			3	17	Moon at apogee
	20	18	Equinox			3	18	Neptune 5° S. of Moon

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h				d	h			
June	4	22	LAST QUARTER			Aug.	10	18	Moon at perigee	
	6	11	Jupiter 7° S. of Moon				12	02	Mercury 2° N. of Moon	
	6	11	Uranus 6° S. of Moon				13	07	Saturn 8° N. of Moon	
	6	15	Mars 0°9 N. of Regulus				13	12	Venus 5° N. of Moon	
	6	19	Jupiter 0°5 S. of Uranus				13	17	Mars 6° N. of Moon	
	9	10	Venus 5° S. of Pollux				16	18	FIRST QUARTER	
	11	03	Mercury 5° S. of Moon				20	04	Mercury stationary	
	12	11	NEW MOON				20	04	Venus greatest elong. E. (46°)	
	15	07	Venus 4° N. of Moon				20	10	Neptune at opposition	
	15	15	Moon at perigee				23	22	Venus 2° S. of Mars	
	16	02	Mercury 5° N. of Aldebaran				24	12	Neptune 5° S. of Moon	
	17	19	Mars 6° N. of Moon				24	17	FULL MOON	
	18	22	Ceres at opposition				25	06	Moon at apogee	
	19	04	FIRST QUARTER				27	07	Uranus 6° S. of Moon	
	19	11	Saturn 8° N. of Moon				27	12	Jupiter 7° S. of Moon	
	21	11	Solstice							
	25	19	Ceres 1°0 S. of Moon	Occn.		Sept.	1	17	LAST QUARTER	
	25	19	Pluto at opposition				1	18	Venus 1°2 S. of Spica	
	26	12	FULL MOON	Eclipse			3	13	Mercury in inferior conjunction	
	28	12	Mercury in superior conjunction				4	14	Mars 2° N. of Spica	
July	1	01	Neptune 5° S. of Moon				8	04	Moon at perigee	
	1	10	Moon at apogee				8	10	NEW MOON	
	3	11	Pallas stationary				9	22	Saturn 8° N. of Moon	
	3	20	Uranus 7° S. of Moon				11	08	Mars 5° N. of Moon	
	4	01	Jupiter 7° S. of Moon				11	13	Venus 0°3 N. of Moon	Occn.
	4	15	LAST QUARTER				12	03	Mercury stationary	
	6	01	Uranus stationary				14	01	Pluto stationary	
	6	11	Earth at aphelion				15	06	FIRST QUARTER	
	9	04	Juno in conjunction with Sun				19	18	Mercury greatest elong. W. (18°)	
	10	03	Venus 1°1 N. of Regulus				20	16	Neptune 5° S. of Moon	
	11	20	NEW MOON	Eclipse			21	08	Moon at apogee	
	13	01	Mercury 4° N. of Moon				21	12	Jupiter at opposition	
	13	11	Moon at perigee				21	17	Uranus at opposition	
	15	01	Venus 6° N. of Moon				22	19	Jupiter 0°9 S. of Uranus	
	16	05	Mars 6° N. of Moon				23	03	Equinox	
	16	19	Saturn 8° N. of Moon				23	09	FULL MOON	
	18	10	FIRST QUARTER				23	11	Jupiter 7° S. of Moon	
	24	04	Jupiter stationary				23	11	Uranus 6° S. of Moon	
	26	02	FULL MOON				23	20	Venus greatest illuminated extent	
	27	23	Mercury 0°3 S. of Regulus				29	06	Venus 6° S. of Mars	
	28	07	Neptune 5° S. of Moon			Oct.	1	01	Saturn in conjunction with Sun	
	29	00	Moon at apogee				1	04	LAST QUARTER	
	31	03	Uranus 6° S. of Moon				6	14	Moon at perigee	
	31	09	Jupiter 7° S. of Moon				7	19	NEW MOON	
Aug.	1	20	Mars 1°9 S. of Saturn				7	19	Venus stationary	
	3	05	LAST QUARTER				9	16	Venus 3° S. of Moon	
	7	01	Mercury greatest elong. E. (27°)				10	02	Mars 4° N. of Moon	
	9	02	Ceres stationary				14	21	FIRST QUARTER	
	10	02	Venus 3° S. of Saturn				17	01	Mercury in superior conjunction	
	10	03	NEW MOON				17	22	Neptune 5° S. of Moon	

CONFIGURATIONS OF SUN, MOON AND PLANETS

	d	h		d	h		
Oct.	18	18	Moon at apogee	Nov.	29	23	Juno 0°5' N. of Moon Occn.
	20	11	Jupiter 7° S. of Moon		30	19	Moon at perigee
	20	15	Uranus 6° S. of Moon	Dec.	1	15	Mercury greatest elong. E. (21°)
	23	02	FULL MOON		1	18	Saturn 8° N. of Moon
	29	01	Venus in inferior conjunction		2	21	Venus 6° N. of Moon
	30	13	LAST QUARTER		4	10	Venus greatest illuminated extent
Nov.	2	00	Juno 0°7' S. of Moon Occn.		5	18	NEW MOON
	3	17	Moon at perigee		6	10	Uranus stationary
	4	06	Saturn 8° N. of Moon		7	09	Mercury 1°8' S. of Moon
	6	05	NEW MOON		10	10	Mercury stationary
	7	08	Neptune stationary		11	15	Neptune 5° S. of Moon
	7	22	Mars 1°6' N. of Moon		13	09	Moon at apogee
	10	00	Vesta in conjunction with Sun		13	14	FIRST QUARTER
	10	04	Mars 4° N. of Antares		14	02	Jupiter 7° S. of Moon
	13	17	FIRST QUARTER		14	06	Uranus 7° S. of Moon
	14	06	Neptune 5° S. of Moon		20	01	Mercury in inferior conjunction
	15	11	Mercury 2° N. of Antares		21	08	FULL MOON Eclipse
	15	12	Moon at apogee		22	00	Solstice
	16	16	Jupiter 7° S. of Moon		22	17	Pallas in conjunction with Sun
	16	16	Venus stationary		25	12	Moon at perigee
	16	22	Uranus 6° S. of Moon		27	01	Pluto in conjunction with Sun
	19	06	Jupiter stationary		28	04	LAST QUARTER
	21	01	Mercury 1°7' S. of Mars		29	03	Saturn 8° N. of Moon
	21	17	FULL MOON		30	08	Mercury stationary
	28	21	LAST QUARTER		31	16	Venus 7° N. of Moon

PREDICTED PERIHELION PASSAGES OF COMETS, 2010

Periodic comet					Periodic comet	Perihelion		Period	
	date		distance			date	distance		
	<i>T</i>		<i>q</i>	<i>P</i>		<i>T</i>	<i>q</i>	<i>P</i>	
			au	years			au	years	
118P/Shoemaker-Levy	Jan.	2	1.98	6.4	104P/Kowal	May	4	1.18	5.9
82P/Gehrels	Jan.	12	3.63	8.4	141P/Machholz	May	24	0.76	5.2
P/2003 XD ₁₀	Jan.	31	1.99	6.3	142P/Ge-Wang	May	30	2.49	11.1
(LINEAR-NEAT)					P/2002 O8 (NEAT)	June	8	3.21	8.1
P/1999 WJ ₇ (Korlevic)	Feb.	8	3.18	10.0	43P/Wolf-Harrington	July	1	1.36	6.1
149P/Mueller	Feb.	19	2.65	9.0	10P/Tempel	July	4	1.42	5.4
157P/Tritton	Feb.	20	1.36	6.3	P/1999 U3 (LINEAR)	July	18	1.92	11.0
81P/Wild	Feb.	22	1.60	6.4	2P/Encke	Aug.	6	0.34	3.3
126P/IRAS	Feb.	22	1.71	13.4	P/2002 S1 (Skiff)	Aug.	14	2.42	8.5
P/2004 R1 (McNaught)	Feb.	23	0.99	5.5	P/2004 EW ₃₈	Sept.	3	1.79	6.8
65P/Gunn	Mar.	2	2.44	6.8	(Catalina-LINEAR)				
P/2002 LZ ₁₁ (LINEAR)	Mar.	6	2.36	7.0	P/2003 UY ₂₇₅ (LINEAR)	Sept.	9	1.83	7.2
162P/Siding Spring	Mar.	8	1.23	5.3	31P/Schwassmann-Wachmann	Sept.	29	3.42	8.7
P/2001 R6	Mar.	26	2.18	8.5	P/2002 X2 (NEAT)	Oct.	4	2.13	7.6
(LINEAR-Skiff)					103P/Hartley	Oct.	28	1.06	6.5
94P/Russell	Mar.	29	2.24	6.6	P/2000 G1 (LINEAR)	Nov.	13	1.00	5.3
30P/Reinmuth	Apr.	19	1.88	7.3	P/2004 HC ₁₈ (LINEAR)	Dec.	29	1.71	6.5

CHRONOLOGICAL CYCLES AND ERAS

Dominical Letter	... .. C	Julian Period (year of)	... .. 6723
Epact	... .. 14	Roman Indiction	... .. 3
Golden Number (Lunar Cycle)	... XVI	Solar Cycle	... .. 3

All dates are given in terms of the Gregorian calendar in which
2010 January 14 corresponds to 2010 January 1 of the Julian calendar.

ERA	YEAR	BEGINS	ERA	YEAR	BEGINS
Byzantine	... .. 7519	Sept. 14	Japanese	... .. 2670	Jan. 1
Jewish (A.M.)*	... .. 5771	Sept. 8	Grecian (Seleucidæ)	... 2322	Sept. 14
Chinese (Geng-yin)	... ..	Feb. 14			(or Oct. 14)
Roman (A.U.C.)	... .. 2763	Jan. 14	Indian (Saka)	... .. 1932	Mar. 22
Nabonassar	... .. 2759	Apr. 21	Diocletian	... .. 1727	Sept. 11
			Islamic (Hegira)*	... 1432	Dec. 7

* Year begins at sunset

RELIGIOUS CALENDARS

Epiphany	... .. Jan. 6	Ascension Day	... .. May 13
Ash Wednesday	... .. Feb. 17	Whit Sunday—Pentecost	... May 23
Palm Sunday	... .. Mar. 28	Trinity Sunday	... .. May 30
Good Friday	... .. Apr. 2	First Sunday in Advent	... .. Nov. 28
Easter Day	... .. Apr. 4	Christmas Day (Saturday)	... Dec. 25
First Day of Passover (Pesach)	Mar. 30	Day of Atonement (Yom Kippur)	Sept. 18
Feast of Weeks (Shavuot)	... May 19	First day of Tabernacles	
Jewish New Year (tabular)		(Succoth)	... .. Sept. 23
(Rosh Hashanah)	... .. Sept. 9	Festival of Lights (Hanukkah)	Dec. 2
First day of Ramadân	... .. Aug. 11	Islamic New Year	... .. Dec. 8
(tabular)		(tabular)	

The Jewish and Islamic dates above are tabular dates, which begin at sunset on the previous evening and end at sunset on the date tabulated. In practice, the dates of Islamic fasts and festivals are determined by an actual sighting of the appropriate new Moon.

CIVIL CALENDAR—UNITED STATES OF AMERICA

New Year's Day	... .. Jan. 1	Labor Day	... .. Sept. 6
Martin Luther King's Birthday	Jan. 18	Columbus Day	... .. Oct. 11
Washington's Birthday	... .. Feb. 15	General Election Day	... .. Nov. 2
Memorial Day	... .. May 31	Veterans Day	... .. Nov. 11
Independence Day	... .. July 4	Thanksgiving Day	... .. Nov. 25

CIVIL CALENDAR—UNITED KINGDOM

Accession of Queen Elizabeth II	Feb. 6	Birthday of Prince Philip,	
St David (Wales)	... .. Mar. 1	Duke of Edinburgh	... .. June 10
Commonwealth Day	... .. Mar. 8	The Queen's Official Birthday†	June 12
St Patrick (Ireland)	... .. Mar. 17	Remembrance Sunday	... .. Nov. 14
Birthday of Queen Elizabeth II	Apr. 21	Birthday of the Prince of Wales	Nov. 14
St George (England)	... .. Apr. 23	St Andrew (Scotland)	... .. Nov. 30
Coronation Day	... .. June 2		

†Date subject to confirmation

CALENDAR, 2010

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Fri.	1	Mon.	32	Mon.	60	Thu.	91	Sat.	121	Tue.	152
2	Sat.	2	Tue.	33	Tue.	61	Fri.	92	Sun.	122	Wed.	153
3	Sun.	3	Wed.	34	Wed.	62	Sat.	93	Mon.	123	Thu.	154
4	Mon.	4	Thu.	35	Thu.	63	Sun.	94	Tue.	124	Fri.	155
5	Tue.	5	Fri.	36	Fri.	64	Mon.	95	Wed.	125	Sat.	156
6	Wed.	6	Sat.	37	Sat.	65	Tue.	96	Thu.	126	Sun.	157
7	Thu.	7	Sun.	38	Sun.	66	Wed.	97	Fri.	127	Mon.	158
8	Fri.	8	Mon.	39	Mon.	67	Thu.	98	Sat.	128	Tue.	159
9	Sat.	9	Tue.	40	Tue.	68	Fri.	99	Sun.	129	Wed.	160
10	Sun.	10	Wed.	41	Wed.	69	Sat.	100	Mon.	130	Thu.	161
11	Mon.	11	Thu.	42	Thu.	70	Sun.	101	Tue.	131	Fri.	162
12	Tue.	12	Fri.	43	Fri.	71	Mon.	102	Wed.	132	Sat.	163
13	Wed.	13	Sat.	44	Sat.	72	Tue.	103	Thu.	133	Sun.	164
14	Thu.	14	Sun.	45	Sun.	73	Wed.	104	Fri.	134	Mon.	165
15	Fri.	15	Mon.	46	Mon.	74	Thu.	105	Sat.	135	Tue.	166
16	Sat.	16	Tue.	47	Tue.	75	Fri.	106	Sun.	136	Wed.	167
17	Sun.	17	Wed.	48	Wed.	76	Sat.	107	Mon.	137	Thu.	168
18	Mon.	18	Thu.	49	Thu.	77	Sun.	108	Tue.	138	Fri.	169
19	Tue.	19	Fri.	50	Fri.	78	Mon.	109	Wed.	139	Sat.	170
20	Wed.	20	Sat.	51	Sat.	79	Tue.	110	Thu.	140	Sun.	171
21	Thu.	21	Sun.	52	Sun.	80	Wed.	111	Fri.	141	Mon.	172
22	Fri.	22	Mon.	53	Mon.	81	Thu.	112	Sat.	142	Tue.	173
23	Sat.	23	Tue.	54	Tue.	82	Fri.	113	Sun.	143	Wed.	174
24	Sun.	24	Wed.	55	Wed.	83	Sat.	114	Mon.	144	Thu.	175
25	Mon.	25	Thu.	56	Thu.	84	Sun.	115	Tue.	145	Fri.	176
26	Tue.	26	Fri.	57	Fri.	85	Mon.	116	Wed.	146	Sat.	177
27	Wed.	27	Sat.	58	Sat.	86	Tue.	117	Thu.	147	Sun.	178
28	Thu.	28	Sun.	59	Sun.	87	Wed.	118	Fri.	148	Mon.	179
29	Fri.	29			Mon.	88	Thu.	119	Sat.	149	Tue.	180
30	Sat.	30			Tue.	89	Fri.	120	Sun.	150	Wed.	181
31	Sun.	31			Wed.	90			Mon.	151		

JULIAN DATE, 2010

0 ^h UT	JD	0 ^h UT	JD	0 ^h UT	JD
Jan. 0	245 5196.5	May 0	245 5316.5	Sept. 0	245 5439.5
Feb. 0	245 5227.5	June 0	245 5347.5	Oct. 0	245 5469.5
Mar. 0	245 5255.5	July 0	245 5377.5	Nov. 0	245 5500.5
Apr. 0	245 5286.5	Aug. 0	245 5408.5	Dec. 0	245 5530.5

400-day date, JD 245 5200.5 = 2010 January 4-0

Standard epoch, 1900 January 0, 12^h UT = JD 241 5020.0
Standard epoch, B1950-0 = 1950 Jan. 0.923 = JD 243 3282.423
B2010-0 = 2010 Jan. 0.455 = JD 245 5196.955

Standard epoch, J2000-0 = 2000 Jan. 1.5 = JD 245 1545.0
J2010.5 = 2010 July 2.625 = JD 245 5380.125

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
Day of Month	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year	Day of Week	Day of Year
1	Thu.	182	Sun.	213	Wed.	244	Fri.	274	Mon.	305	Wed.	335
2	Fri.	183	Mon.	214	Thu.	245	Sat.	275	Tue.	306	Thu.	336
3	Sat.	184	Tue.	215	Fri.	246	Sun.	276	Wed.	307	Fri.	337
4	Sun.	185	Wed.	216	Sat.	247	Mon.	277	Thu.	308	Sat.	338
5	Mon.	186	Thu.	217	Sun.	248	Tue.	278	Fri.	309	Sun.	339
6	Tue.	187	Fri.	218	Mon.	249	Wed.	279	Sat.	310	Mon.	340
7	Wed.	188	Sat.	219	Tue.	250	Thu.	280	Sun.	311	Tue.	341
8	Thu.	189	Sun.	220	Wed.	251	Fri.	281	Mon.	312	Wed.	342
9	Fri.	190	Mon.	221	Thu.	252	Sat.	282	Tue.	313	Thu.	343
10	Sat.	191	Tue.	222	Fri.	253	Sun.	283	Wed.	314	Fri.	344
11	Sun.	192	Wed.	223	Sat.	254	Mon.	284	Thu.	315	Sat.	345
12	Mon.	193	Thu.	224	Sun.	255	Tue.	285	Fri.	316	Sun.	346
13	Tue.	194	Fri.	225	Mon.	256	Wed.	286	Sat.	317	Mon.	347
14	Wed.	195	Sat.	226	Tue.	257	Thu.	287	Sun.	318	Tue.	348
15	Thu.	196	Sun.	227	Wed.	258	Fri.	288	Mon.	319	Wed.	349
16	Fri.	197	Mon.	228	Thu.	259	Sat.	289	Tue.	320	Thu.	350
17	Sat.	198	Tue.	229	Fri.	260	Sun.	290	Wed.	321	Fri.	351
18	Sun.	199	Wed.	230	Sat.	261	Mon.	291	Thu.	322	Sat.	352
19	Mon.	200	Thu.	231	Sun.	262	Tue.	292	Fri.	323	Sun.	353
20	Tue.	201	Fri.	232	Mon.	263	Wed.	293	Sat.	324	Mon.	354
21	Wed.	202	Sat.	233	Tue.	264	Thu.	294	Sun.	325	Tue.	355
22	Thu.	203	Sun.	234	Wed.	265	Fri.	295	Mon.	326	Wed.	356
23	Fri.	204	Mon.	235	Thu.	266	Sat.	296	Tue.	327	Thu.	357
24	Sat.	205	Tue.	236	Fri.	267	Sun.	297	Wed.	328	Fri.	358
25	Sun.	206	Wed.	237	Sat.	268	Mon.	298	Thu.	329	Sat.	359
26	Mon.	207	Thu.	238	Sun.	269	Tue.	299	Fri.	330	Sun.	360
27	Tue.	208	Fri.	239	Mon.	270	Wed.	300	Sat.	331	Mon.	361
28	Wed.	209	Sat.	240	Tue.	271	Thu.	301	Sun.	332	Tue.	362
29	Thu.	210	Sun.	241	Wed.	272	Fri.	302	Mon.	333	Wed.	363
30	Fri.	211	Mon.	242	Thu.	273	Sat.	303	Tue.	334	Thu.	364
31	Sat.	212	Tue.	243			Sun.	304			Fri.	365

MEAN SIDEREAL TIME, 2010

Greenwich mean sidereal time at 0^h UT

	^h		^h		^h		^h
Jan. 0	6-6368	Apr. 0	12-5507	July 0	18-5303	Oct. 0	0-5756
Feb. 0	8-6738	May 0	14-5220	Aug. 0	20-5673	Nov. 0	2-6126
Mar. 0	10-5137	June 0	16-5590	Sept. 0	22-6043	Dec. 0	4-5839

Greenwich mean sidereal time (GMST) on day d of month at hour t UT

$$= \text{GMST at } 0^{\text{h}} \text{ UT on day } 0 + 0^{\text{h}}065\,71\,d + 1^{\text{h}}002\,74\,t$$

$$\text{Local mean sidereal time} = \text{GMST} \begin{array}{l} + \text{east} \\ - \text{west} \end{array} \text{ longitude}$$

AT 0^h UNIVERSAL TIME

Equation Date of time	Declin- ation	Equation Date of time	Declin- ation	Equation Date of time	Declin- ation	Equation Date of time	Declin- ation
Jan. 0 ^m -02 50 ^s	-23 06	Feb. 15 ^m -14 08 ^s	-12 47	Apr. 1 ^m -04 02 ^s	+04 25	May 17 ^m +03 38 ^s	+19 15
1 03 18	23 02	16 14 05	12 27	2 03 44	04 48	18 03 36	19 29
2 03 46	22 57	17 14 02	12 06	3 03 26	05 11	19 03 33	19 42
3 04 14	22 51	18 13 57	11 45	4 03 09	05 34	20 03 30	19 55
4 04 42	22 45	19 13 52	11 24	5 02 51	05 57	21 03 27	20 07
5 -05 09	-22 39	20 -13 46	-11 02	6 -02 34	+06 20	22 +03 23	+20 19
6 05 35	22 32	21 13 40	10 41	7 02 17	06 42	23 03 18	20 31
7 06 02	22 25	22 13 33	10 19	8 02 00	07 05	24 03 13	20 42
8 06 27	22 17	23 13 25	09 57	9 01 44	07 27	25 03 08	20 53
9 06 53	22 09	24 13 17	09 35	10 01 27	07 50	26 03 02	21 04
10 -07 17	-22 00	25 -13 08	-09 13	11 -01 11	+08 12	27 +02 55	+21 14
11 07 42	21 51	26 12 58	08 50	12 00 56	08 34	28 02 48	21 24
12 08 05	21 42	27 12 48	08 28	13 00 40	08 56	29 02 41	21 34
13 08 28	21 32	28 12 37	08 05	14 00 25	09 17	30 02 33	21 43
14 08 51	21 22	Mar. 1 12 26	07 43	15 -00 10	09 39	31 02 25	21 52
15 -09 13	-21 11	2 -12 14	-07 20	16 +00 04	+10 00	June 1 +02 16	+22 01
16 09 34	21 00	3 12 02	06 57	17 00 18	10 22	2 02 07	22 09
17 09 54	20 48	4 11 49	06 34	18 00 32	10 43	3 01 57	22 16
18 10 14	20 36	5 11 36	06 11	19 00 45	11 04	4 01 48	22 24
19 10 33	20 24	6 11 23	05 48	20 00 58	11 24	5 01 37	22 31
20 -10 52	-20 11	7 -11 09	-05 24	21 +01 10	+11 45	6 +01 27	+22 37
21 11 09	19 58	8 10 54	05 01	22 01 23	12 05	7 01 16	22 43
22 11 26	19 45	9 10 40	04 38	23 01 34	12 25	8 01 04	22 49
23 11 42	19 31	10 10 25	04 14	24 01 45	12 45	9 00 53	22 54
24 11 57	19 17	11 10 09	03 51	25 01 56	13 05	10 00 41	22 59
25 -12 11	-19 02	12 -09 53	-03 27	26 +02 07	+13 25	11 +00 29	+23 04
26 12 25	18 48	13 09 37	03 03	27 02 16	13 44	12 00 16	23 08
27 12 38	18 32	14 09 21	02 40	28 02 26	14 03	13 +00 04	23 11
28 12 50	18 17	15 09 05	02 16	29 02 35	14 22	14 -00 09	23 15
29 13 01	18 01	16 08 48	01 52	30 02 43	14 40	15 00 22	23 18
30 -13 11	-17 45	17 -08 31	-01 29	May 1 +02 51	+14 59	16 -00 34	+23 20
31 13 21	17 28	18 08 14	01 05	2 02 58	15 17	17 00 47	23 22
Feb. 1 13 29	17 11	19 07 56	00 41	3 03 05	15 35	18 01 00	23 24
2 13 37	16 54	20 07 39	-00 17	4 03 11	15 52	19 01 14	23 25
3 13 44	16 37	21 07 21	+00 06	5 03 16	16 10	20 01 27	23 26
4 -13 51	-16 19	22 -07 03	+00 30	6 +03 21	+16 27	21 -01 40	+23 26
5 13 56	16 01	23 06 45	00 54	7 03 26	16 43	22 01 53	23 26
6 14 01	15 43	24 06 27	01 17	8 03 30	17 00	23 02 06	23 26
7 14 05	15 24	25 06 09	01 41	9 03 33	17 16	24 02 19	23 25
8 14 08	15 06	26 05 51	02 05	10 03 35	17 32	25 02 31	23 24
9 -14 10	-14 47	27 -05 33	+02 28	11 +03 37	+17 48	26 -02 44	+23 22
10 14 12	14 27	28 05 15	02 52	12 03 39	18 03	27 02 56	23 20
11 14 12	14 08	29 04 56	03 15	13 03 40	18 18	28 03 09	23 18
12 14 13	13 48	30 04 38	03 38	14 03 40	18 33	29 03 21	23 15
13 14 12	13 28	31 04 20	04 02	15 03 40	18 47	30 03 33	23 11
14 -14 10	-13 08	Apr. 1 -04 02	+04 25	16 +03 39	+19 02	July 1 -03 45	+23 08
15 -14 08	-12 47	2 -03 44	+04 48	17 +03 38	+19 15	2 -03 56	+23 04

Equation of time = apparent time - mean time

AT 0^h UNIVERSAL TIME

Date	Equation of time	Declin- ation	Date	Equation of time	Declin- ation	Date	Equation of time	Declin- ation	Date	Equation of time	Declin- ation
July	^m _s	[°] _'	Aug. 16	^m _s	[°] _'	Oct. 1	^m _s	[°] _'	Nov. 16	^m _s	[°] _'
1	-03 45	+23 08	17	-04 24	+13 50	2	+10 09	-03 04	17	+15 19	-18 39
2	03 56	23 04	18	04 12	13 31	3	10 28	03 27	18	15 08	18 54
3	04 07	22 59	19	03 59	13 12	4	10 47	03 50	19	14 57	19 09
4	04 18	22 54	20	03 46	12 52	5	11 06	04 13	20	14 44	19 23
5	04 29	22 49	21	03 32	12 33	6	11 24	04 36	21	14 31	19 37
6	-04 40	+22 43	22	-03 17	+12 13	7	+11 42	-05 00	22	+14 17	-19 50
7	04 50	22 37	23	03 03	11 53	8	12 00	05 23	23	14 02	20 03
8	04 59	22 31	24	02 47	11 33	9	12 17	05 46	24	13 46	20 16
9	05 09	22 24	25	02 31	11 13	10	12 34	06 08	25	13 29	20 29
10	05 18	22 16	26	02 15	10 52	11	12 50	06 31	26	13 12	20 41
11	-05 26	+22 09	27	-01 58	+10 31	12	+13 06	-06 54	27	+12 54	-20 52
12	05 34	22 01	28	01 41	10 10	13	13 21	07 17	28	12 35	21 04
13	05 42	21 52	29	01 24	09 49	14	13 36	07 39	29	12 15	21 15
14	05 49	21 43	30	01 06	09 28	15	13 51	08 01	30	11 55	21 25
15	05 55	21 34	31	00 48	09 07	16	14 05	08 24	31	11 34	21 35
16	-06 02	+21 25	Sept. 1	-00 30	+08 45	17	+14 18	-08 46	Dec. 1	+11 12	-21 45
17	06 07	21 15	2	-00 11	08 24	18	14 31	09 08	2	10 49	21 54
18	06 12	21 05	3	+00 08	08 02	19	14 43	09 30	3	10 26	22 03
19	06 17	20 54	4	00 27	07 40	20	14 55	09 52	4	10 02	22 11
20	06 21	20 43	5	00 47	07 18	21	15 06	10 13	5	09 38	22 19
21	-06 24	+20 32	6	+01 07	+06 56	22	+15 16	-10 35	6	+09 13	-22 27
22	06 27	20 20	7	01 27	06 34	23	15 26	10 56	7	08 48	22 34
23	06 29	20 08	8	01 47	06 11	24	15 35	11 17	8	08 22	22 41
24	06 31	19 56	9	02 07	05 49	25	15 43	11 38	9	07 55	22 47
25	06 32	19 43	10	02 28	05 26	26	15 51	11 59	10	07 29	22 53
26	-06 32	+19 30	11	+02 49	+05 03	27	+15 58	-12 20	11	+07 01	-22 58
27	06 32	19 17	12	03 10	04 41	28	16 04	12 40	12	06 34	23 03
28	06 31	19 03	13	03 31	04 18	29	16 10	13 00	13	06 06	23 07
29	06 30	18 49	14	03 52	03 55	30	16 14	13 20	14	05 37	23 11
30	06 28	18 35	15	04 13	03 32	31	16 18	13 40	15	05 09	23 15
31	-06 25	+18 21	16	+04 34	+03 09	Nov. 1	+16 21	-14 00	16	+04 40	-23 18
Aug. 1	06 22	18 06	17	04 56	02 46	2	16 24	14 19	17	04 11	23 20
2	06 18	17 51	18	05 17	02 23	3	16 25	14 39	18	03 42	23 23
3	06 14	17 35	19	05 39	02 00	4	16 26	14 57	19	03 12	23 24
4	06 09	17 19	20	06 00	01 36	5	16 26	15 16	20	02 43	23 25
5	-06 03	+17 03	21	+06 22	+01 13	6	+16 25	-15 35	21	+02 13	-23 26
6	05 57	16 47	22	06 43	00 50	7	16 23	15 53	22	01 43	23 26
7	05 51	16 30	23	07 04	00 26	8	16 20	16 11	23	01 14	23 26
8	05 43	16 14	24	07 25	+00 03	9	16 17	16 28	24	00 44	23 25
9	05 35	15 57	25	07 47	-00 20	10	16 13	16 46	25	+00 14	23 24
10	-05 27	+15 39	26	+08 08	-00 44	11	+16 08	-17 03	26	-00 16	-23 22
11	05 18	15 22	27	08 28	01 07	12	16 02	17 20	27	00 45	23 20
12	05 08	15 04	28	08 49	01 30	13	15 55	17 36	28	01 15	23 18
13	04 58	14 46	29	09 09	01 54	14	15 47	17 52	29	01 44	23 15
14	04 48	14 27	30	09 30	02 17	15	15 39	18 08	30	02 13	23 11
15	-04 36	+14 09	Oct. 1	+09 49	-02 40	16	+15 29	-18 24	31	-02 42	-23 07
16	-04 24	+13 50	2	+10 09	-03 04	17	+15 19	-18 39	32	-03 11	-23 03

UT of transit = 12^{h} $\begin{smallmatrix} - & \text{east} \\ + & \text{west} \end{smallmatrix}$ longitude - equation of time

CIRCUMPOLAR STARS, 2010

AT 0^h UNIVERSAL TIME

Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA
Jan. 0	58 19	140 22	Feb. 15	103 58	185 44	Apr. 1	148 35	229 57	May 17	193 55	275 04
1	59 19	141 21	16	104 58	186 43	2	149 34	230 56	18	194 54	276 03
2	60 18	142 21	17	105 58	187 42	3	150 33	231 55	19	195 53	277 01
3	61 18	143 20	18	106 57	188 41	4	151 33	232 54	20	196 52	278 00
4	62 17	144 19	19	107 57	189 40	5	152 32	233 52	21	197 51	278 59
5	63 17	145 18	20	108 56	190 39	6	153 31	234 51	22	198 50	279 58
6	64 16	146 18	21	109 56	191 38	7	154 30	235 50	23	199 49	280 57
7	65 16	147 17	22	110 55	192 37	8	155 30	236 49	24	200 48	281 56
8	66 15	148 16	23	111 55	193 36	9	156 29	237 48	25	201 47	282 55
9	67 15	149 15	24	112 54	194 35	10	157 28	238 47	26	202 45	283 53
10	68 14	150 15	25	113 54	195 34	11	158 28	239 45	27	203 44	284 52
11	69 14	151 14	26	114 53	196 33	12	159 27	240 44	28	204 43	285 51
12	70 13	152 13	27	115 53	197 32	13	160 26	241 43	29	205 42	286 50
13	71 13	153 12	28	116 53	198 31	14	161 25	242 42	30	206 41	287 49
14	72 12	154 12	Mar. 1	117 52	199 30	15	162 25	243 41	31	207 40	288 48
15	73 12	155 11	2	118 52	200 29	16	163 24	244 40	June 1	208 38	289 46
16	74 11	156 10	3	119 51	201 28	17	164 23	245 39	2	209 37	290 45
17	75 11	157 09	4	120 51	202 27	18	165 22	246 38	3	210 36	291 44
18	76 10	158 08	5	121 50	203 26	19	166 21	247 36	4	211 35	292 43
19	77 10	159 07	6	122 50	204 25	20	167 20	248 35	5	212 34	293 42
20	78 10	160 07	7	123 49	205 24	21	168 20	249 34	6	213 33	294 41
21	79 09	161 06	8	124 49	206 23	22	169 19	250 33	7	214 32	295 40
22	80 09	162 05	9	125 48	207 22	23	170 18	251 32	8	215 31	296 38
23	81 08	163 04	10	126 47	208 21	24	171 17	252 31	9	216 29	297 37
24	82 08	164 03	11	127 47	209 20	25	172 16	253 29	10	217 28	298 36
25	83 07	165 03	12	128 47	210 19	26	173 16	254 28	11	218 27	299 35
26	84 07	166 02	13	129 46	211 17	27	174 15	255 27	12	219 26	300 34
27	85 06	167 01	14	130 46	212 16	28	175 14	256 26	13	220 24	301 33
28	86 06	168 00	15	131 45	213 15	29	176 13	257 25	14	221 23	302 32
29	87 05	168 59	16	132 45	214 14	30	177 12	258 24	15	222 22	303 31
30	88 05	169 58	17	133 44	215 13	May 1	178 11	259 23	16	223 21	304 29
31	89 05	170 57	18	134 43	216 12	2	179 10	260 21	17	224 19	305 28
Feb. 1	90 04	171 56	19	135 43	217 11	3	180 09	261 20	18	225 18	306 27
2	91 04	172 56	20	136 42	218 10	4	181 08	262 19	19	226 17	307 26
3	92 04	173 55	21	137 42	219 09	5	182 07	263 18	20	227 16	308 25
4	93 03	174 54	22	138 41	220 08	6	183 06	264 17	21	228 15	309 24
5	94 03	175 53	23	139 40	221 07	7	184 05	265 15	22	229 13	310 23
6	95 02	176 52	24	140 40	222 06	8	185 04	266 14	23	230 12	311 22
7	96 02	177 51	25	141 39	223 05	9	186 03	267 13	24	231 11	312 21
8	97 01	178 50	26	142 38	224 03	10	187 02	268 12	25	232 09	313 19
9	98 01	179 49	27	143 38	225 02	11	188 01	269 11	26	233 08	314 18
10	99 00	180 48	28	144 37	226 01	12	189 00	270 10	27	234 07	315 17
11	100 00	181 47	29	145 37	227 00	13	189 59	271 09	28	235 05	316 16
12	101 00	182 46	30	146 36	227 59	14	190 58	272 07	29	236 04	317 15
13	101 59	183 46	31	147 35	228 58	15	191 57	273 06	30	237 03	318 14
14	102 59	184 45	Apr. 1	148 35	229 57	16	192 56	274 05	July 1	238 02	319 13
15	103 58	185 44	2	149 34	230 56	17	193 55	275 04	2	239 00	320 12

The dates between Jan. 0 and Dec. 32 below are the dates when *p* changes to the next value.

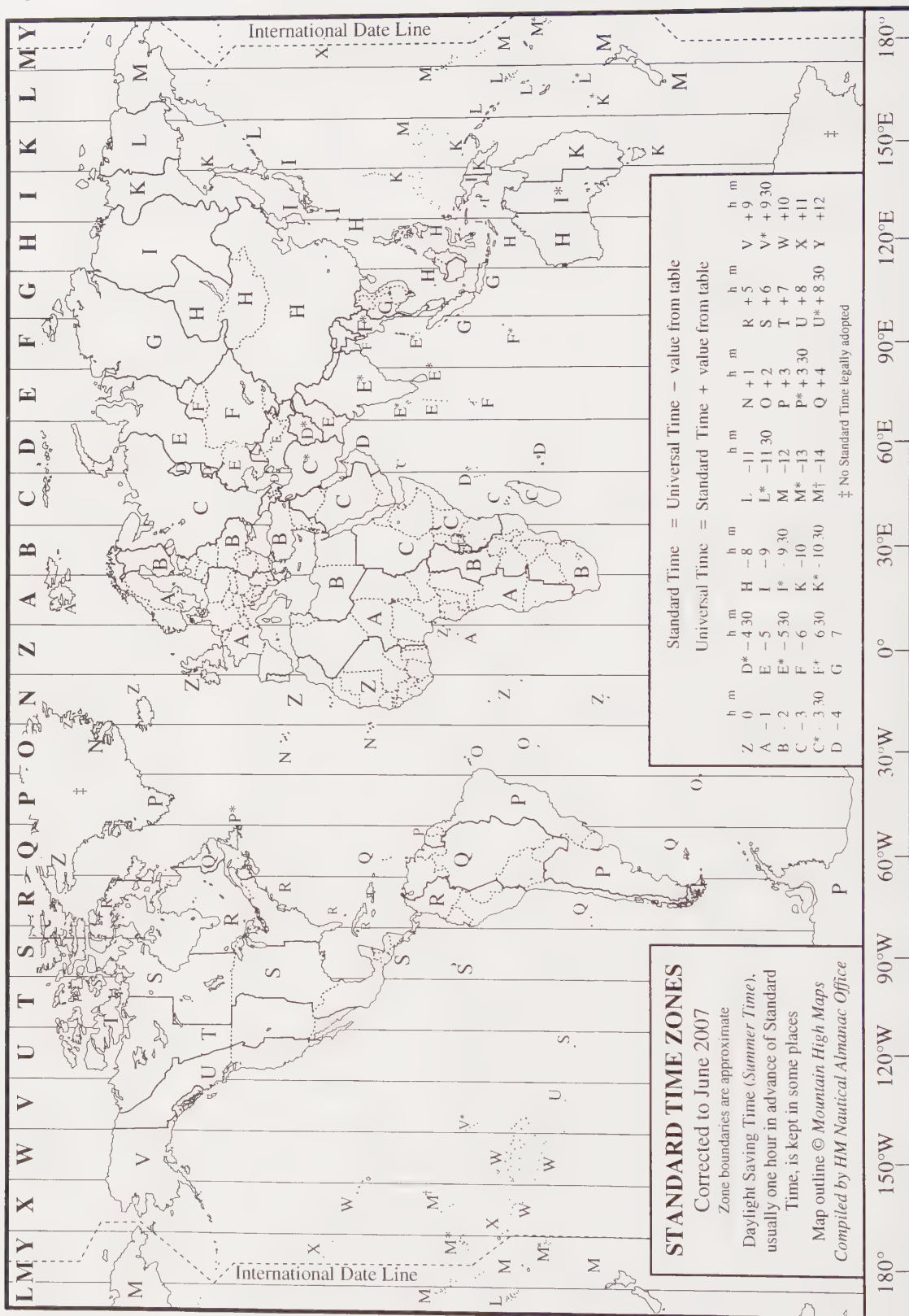
Polar Distance (<i>p</i>)	<i>Polaris</i> :	Jan. 0	41'	May 23	42'	Sept. 21	41'	Dec. 32
	σ Octantis:	Jan. 0	65'	Apr. 13	66'	July 8	65'	Dec. 32

AT 0^h UNIVERSAL TIME

Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA	Date	<i>Polaris</i> GHA	σ Oct GHA
July	1 238 02	319 13	Aug. 16	283 00	4 28	Oct. 1	328 01	49 53	Nov. 16	13 13	95 26
2	239 00	320 12	17	283 59	5 27	2	329 00	50 52	17	14 12	96 25
3	239 59	321 11	18	284 57	6 26	3	329 59	51 52	18	15 12	97 24
4	240 58	322 10	19	285 56	7 25	4	330 57	52 51	19	16 11	98 24
5	241 57	323 09	20	286 54	8 24	5	331 56	53 50	20	17 10	99 23
6	242 55	324 08	21	287 53	9 23	6	332 55	54 50	21	18 09	100 23
7	243 54	325 07	22	288 52	10 23	7	333 54	55 49	22	19 08	101 22
8	244 52	326 06	23	289 50	11 22	8	334 53	56 49	23	20 07	102 22
9	245 51	327 04	24	290 49	12 21	9	335 52	57 48	24	21 06	103 21
10	246 50	328 03	25	291 48	13 20	10	336 51	58 47	25	22 06	104 20
11	247 48	329 02	26	292 47	14 19	11	337 49	59 47	26	23 05	105 20
12	248 47	330 01	27	293 45	15 18	12	338 48	60 46	27	24 04	106 19
13	249 46	331 00	28	294 44	16 18	13	339 47	61 46	28	25 03	107 19
14	250 44	331 59	29	295 43	17 17	14	340 46	62 45	29	26 03	108 18
15	251 43	332 58	30	296 41	18 16	15	341 45	63 44	30	27 02	109 17
16	252 42	333 57	31	297 40	19 15	16	342 44	64 44	Dec. 1	28 01	110 17
17	253 41	334 56	Sept. 1	298 39	20 15	17	343 43	65 43	2	29 00	111 16
18	254 39	335 55	2	299 37	21 14	18	344 42	66 42	3	30 00	112 16
19	255 38	336 54	3	300 36	22 13	19	345 41	67 42	4	30 59	113 15
20	256 36	337 53	4	301 35	23 12	20	346 40	68 41	5	31 58	114 14
21	257 35	338 52	5	302 33	24 11	21	347 39	69 41	6	32 57	115 14
22	258 34	339 51	6	303 32	25 11	22	348 37	70 40	7	33 56	116 13
23	259 32	340 50	7	304 31	26 10	23	349 36	71 40	8	34 56	117 13
24	260 31	341 49	8	305 30	27 09	24	350 35	72 39	9	35 55	118 12
25	261 30	342 48	9	306 28	28 08	25	351 34	73 38	10	36 54	119 11
26	262 28	343 47	10	307 27	29 08	26	352 33	74 38	11	37 54	120 11
27	263 27	344 46	11	308 26	30 07	27	353 32	75 37	12	38 53	121 10
28	264 26	345 45	12	309 24	31 06	28	354 31	76 37	13	39 53	122 09
29	265 24	346 44	13	310 23	32 06	29	355 30	77 36	14	40 52	123 09
30	266 23	347 43	14	311 22	33 05	30	356 29	78 35	15	41 51	124 08
31	267 22	348 42	15	312 20	34 04	31	357 28	79 35	16	42 51	125 07
Aug. 1	268 20	349 41	16	313 19	35 03	Nov. 1	358 27	80 34	17	43 50	126 07
2	269 19	350 40	17	314 18	36 03	2	359 26	81 34	18	44 49	127 06
3	270 18	351 40	18	315 17	37 02	3	0 25	82 33	19	45 49	128 06
4	271 16	352 39	19	316 15	38 01	4	1 24	83 33	20	46 48	129 05
5	272 15	353 38	20	317 14	39 00	5	2 23	84 32	21	47 47	130 04
6	273 13	354 37	21	318 13	40 00	6	3 22	85 31	22	48 47	131 03
7	274 12	355 36	22	319 12	40 59	7	4 21	86 31	23	49 46	132 03
8	275 11	356 35	23	320 11	41 58	8	5 20	87 30	24	50 46	133 02
9	276 09	357 34	24	321 10	42 58	9	6 19	88 30	25	51 45	134 01
10	277 08	358 33	25	322 08	43 57	10	7 18	89 29	26	52 45	135 01
11	278 07	359 32	26	323 07	44 56	11	8 17	90 29	27	53 44	136 00
12	279 05	0 31	27	324 06	45 56	12	9 17	91 28	28	54 44	136 59
13	280 04	1 30	28	325 05	46 55	13	10 16	92 27	29	55 43	137 59
14	281 03	2 29	29	326 03	47 54	14	11 15	93 27	30	56 42	138 58
15	282 01	3 29	30	327 02	48 54	15	12 14	94 26	31	57 42	139 57
16	283 00	4 28	Oct. 1	328 01	49 53	16	13 13	95 26	32	58 41	140 56

Form the quantities $C = p \cos(\text{local hour angle})$ and $S = p \sin(\text{local hour angle})$ then
Latitude = $h_0 - C + 0.0087 S^2 \tan h_0$,
Azimuth of *Polaris* = $-S / \cos h_0$ and Azimuth of σ Octantis = $180^\circ + S / \cos h_0$, where p and h_0
are in degrees and h_0 is the observed altitude corrected for atmospheric refraction and instrument error.

WORLD MAP OF TIME ZONES



The times of sunrise and sunset (pages 24–31) and of moonrise and moonset (pages 32–63) are the instants when the upper limbs of the Sun and Moon appear to lie on the horizon for an observer at sea-level. In both cases a fixed allowance of 34' has been made for refraction; a further allowance of 16' has been made for the semidiameter of the Sun, while for the Moon the actual value of semidiameter *minus* horizontal parallax has been used. No allowance has been made for the phase of the Moon. The observed times may differ from the tabular times because of variations in refraction and the relative heights of the observer and horizon.

The tabular values are for the universal time (UT) of the phenomena on the Greenwich meridian (longitude 0°). To a first approximation the UT at another longitude is given by subtracting the longitude, expressed in time-measure, if east of Greenwich, or by adding, if west of Greenwich. Alternatively the tables may be regarded as giving the approximate local mean time on all meridians. These times may be converted to standard time by applying the appropriate differences, as indicated in the note on page 4. Linear interpolation may be used to obtain the times for non-tabular latitudes.

In the case of the Sun it may be necessary to interpolate (mentally) to obtain the UT for an intermediate date, but a further interpolation for longitude is not normally required. In the case of the Moon the values must normally be interpolated for longitude, as well as for latitude, since the changes in the tabular values from one day to the next are usually large. The interpolating factor is equal to one twenty-fourth of the longitude if expressed in hours and decimals of an hour; linear interpolation is usually adequate.

Example

To find the times of sunrise and sunset and of moonrise and moonset on 2010 February 25 at latitude N 38° 55', longitude W 77° 15'. The longitude expressed in time-measure is W 05^h 09^m. The difference between standard time and UT is –5^h in this case.

The relevant tabular values in UT for longitude 0° are as follows:

		Sunrise		Sunset				Moonrise		Moonset	
		+35°	+40°	+35°	+40°			+35°	+40°	+35°	+40°
	d	h m	h m	h m	h m		d	h m	h m	h m	h m
Feb. 23		06 37	06 42	17 50	17 45	Feb. 25		14 17	14 04	04 01	04 16
27		06 32	06 37	17 54	17 49	26		15 32	15 21	04 47	04 58

Interpolating factor for latitude is 3° 55' / 5° = 0.78
 for date for Sun is 2^d / 4^d = 0.50
 for long. for Moon is 5^h 15 / 24^h = 0.21

		Sunrise		Sunset	Moonrise		Moonset
		d	h m	h m	d	h m	h m
Interpolation to:							
Latitude N 38° 55'	Feb. 23		06 41	17 46	Feb. 25	14 07	04 13
N 38° 55'	27		06 36	17 50	26	15 23	04 56
Local mean time	25		06 38	17 48	25	14 23	04 22
Adjustment to:							
Universal time	25		11 47	22 57	25	19 32	09 31
Standard time	25		06 47	17 57	25	14 32	04 31

SUNRISE AND SUNSET, 2010
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −2	3 23	3 52	4 15	4 32	4 47	5 00	5 22	5 41	5 58	6 16	6 34	6 55	7 07	7 21
2	3 27	3 56	4 18	4 36	4 50	5 03	5 25	5 43	6 00	6 17	6 35	6 56	7 08	7 22
6	3 33	4 01	4 22	4 39	4 54	5 06	5 27	5 45	6 02	6 19	6 37	6 57	7 09	7 22
10	3 39	4 06	4 27	4 43	4 57	5 09	5 30	5 47	6 04	6 20	6 37	6 57	7 08	7 22
14	3 46	4 12	4 31	4 47	5 01	5 13	5 32	5 50	6 05	6 21	6 38	6 57	7 08	7 20
18	3 53	4 18	4 37	4 52	5 05	5 16	5 35	5 52	6 07	6 22	6 38	6 56	7 07	7 19
22	4 01	4 24	4 42	4 57	5 09	5 20	5 38	5 53	6 08	6 22	6 38	6 55	7 05	7 17
26	4 09	4 31	4 48	5 01	5 13	5 23	5 40	5 55	6 09	6 23	6 37	6 53	7 03	7 14
30	4 18	4 38	4 54	5 06	5 17	5 27	5 43	5 57	6 10	6 23	6 36	6 52	7 00	7 11
Feb. 3	4 26	4 45	4 59	5 11	5 21	5 30	5 45	5 58	6 10	6 22	6 35	6 49	6 57	7 07
7	4 35	4 52	5 05	5 16	5 25	5 34	5 47	5 59	6 11	6 22	6 33	6 46	6 54	7 03
11	4 44	4 59	5 11	5 21	5 30	5 37	5 50	6 01	6 11	6 21	6 31	6 43	6 50	6 58
15	4 53	5 06	5 17	5 26	5 34	5 40	5 52	6 02	6 11	6 20	6 29	6 40	6 46	6 53
19	5 01	5 13	5 23	5 31	5 37	5 43	5 54	6 02	6 10	6 18	6 27	6 36	6 42	6 48
23	5 10	5 20	5 28	5 35	5 41	5 46	5 55	6 03	6 10	6 17	6 24	6 32	6 37	6 42
27	5 18	5 27	5 34	5 40	5 45	5 49	5 57	6 03	6 09	6 15	6 21	6 28	6 32	6 37
Mar. 3	5 26	5 34	5 40	5 44	5 49	5 52	5 58	6 04	6 09	6 13	6 18	6 24	6 27	6 31
7	5 35	5 40	5 45	5 49	5 52	5 55	6 00	6 04	6 08	6 11	6 15	6 19	6 22	6 25
11	5 43	5 47	5 50	5 53	5 55	5 58	6 01	6 04	6 07	6 09	6 12	6 15	6 16	6 18
15	5 51	5 53	5 56	5 57	5 59	6 00	6 02	6 04	6 06	6 07	6 09	6 10	6 11	6 12
19	5 59	6 00	6 01	6 02	6 02	6 03	6 03	6 04	6 05	6 05	6 05	6 05	6 05	6 05
23	6 07	6 06	6 06	6 06	6 05	6 05	6 05	6 04	6 03	6 03	6 02	6 01	6 00	5 59
27	6 14	6 13	6 11	6 10	6 09	6 08	6 06	6 04	6 02	6 00	5 58	5 56	5 54	5 52
31	6 22	6 19	6 16	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 55	5 51	5 49	5 46
Apr. 4	6 30	6 25	6 21	6 18	6 15	6 12	6 08	6 04	6 00	5 56	5 51	5 46	5 43	5 40

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. −2	20 41	20 12	19 49	19 32	19 17	19 04	18 42	18 23	18 06	17 49	17 30	17 09	16 57	16 43
2	20 40	20 11	19 50	19 32	19 17	19 05	18 43	18 25	18 08	17 51	17 33	17 12	17 00	16 46
6	20 38	20 10	19 49	19 32	19 18	19 05	18 44	18 26	18 10	17 53	17 35	17 15	17 03	16 50
10	20 35	20 08	19 48	19 31	19 18	19 06	18 45	18 28	18 11	17 55	17 38	17 18	17 07	16 54
14	20 31	20 06	19 46	19 30	19 17	19 05	18 45	18 28	18 13	17 57	17 40	17 21	17 10	16 58
18	20 26	20 02	19 43	19 28	19 16	19 04	18 46	18 29	18 14	17 59	17 43	17 25	17 14	17 02
22	20 21	19 58	19 40	19 26	19 14	19 03	18 45	18 30	18 15	18 01	17 46	17 28	17 18	17 07
26	20 14	19 53	19 36	19 23	19 12	19 02	18 44	18 30	18 16	18 03	17 48	17 32	17 22	17 12
30	20 07	19 48	19 32	19 20	19 09	18 59	18 43	18 30	18 17	18 04	17 51	17 35	17 27	17 16
Feb. 3	20 00	19 42	19 27	19 16	19 06	18 57	18 42	18 29	18 17	18 05	17 53	17 39	17 31	17 21
7	19 52	19 35	19 22	19 11	19 02	18 54	18 40	18 29	18 18	18 07	17 55	17 42	17 35	17 26
11	19 43	19 28	19 16	19 07	18 58	18 51	18 39	18 28	18 18	18 08	17 57	17 45	17 39	17 31
15	19 34	19 21	19 10	19 02	18 54	18 48	18 36	18 27	18 18	18 09	17 59	17 49	17 42	17 36
19	19 25	19 13	19 04	18 56	18 50	18 44	18 34	18 25	18 17	18 09	18 01	17 52	17 46	17 40
23	19 16	19 05	18 57	18 51	18 45	18 40	18 31	18 24	18 17	18 10	18 03	17 55	17 50	17 45
27	19 06	18 57	18 50	18 45	18 40	18 36	18 28	18 22	18 16	18 10	18 04	17 58	17 54	17 49
Mar. 3	18 56	18 49	18 43	18 39	18 35	18 31	18 25	18 20	18 15	18 11	18 06	18 00	17 57	17 54
7	18 46	18 41	18 36	18 33	18 29	18 27	18 22	18 18	18 14	18 11	18 07	18 03	18 01	17 58
11	18 36	18 32	18 29	18 26	18 24	18 22	18 19	18 16	18 13	18 11	18 08	18 06	18 04	18 02
15	18 26	18 23	18 21	18 20	18 18	18 17	18 15	18 14	18 12	18 11	18 10	18 08	18 07	18 07
19	18 16	18 15	18 14	18 13	18 13	18 12	18 12	18 11	18 11	18 11	18 11	18 11	18 11	18 11
23	18 06	18 06	18 06	18 07	18 07	18 08	18 08	18 09	18 10	18 11	18 12	18 13	18 14	18 15
27	17 55	17 57	17 59	18 00	18 02	18 03	18 05	18 07	18 09	18 11	18 13	18 16	18 17	18 19
31	17 45	17 49	17 52	17 54	17 56	17 58	18 01	18 04	18 07	18 11	18 14	18 18	18 20	18 23
Apr. 4	17 35	17 40	17 44	17 48	17 51	17 53	17 58	18 02	18 06	18 10	18 15	18 20	18 24	18 27

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -2	7 21	7 28	7 34	7 42	7 50	7 58	8 08	8 19	8 32	8 46	9 03	9 24	9 52	10 32
2	7 22	7 28	7 35	7 42	7 50	7 58	8 08	8 19	8 31	8 45	9 02	9 22	9 49	10 26
6	7 22	7 28	7 35	7 42	7 49	7 58	8 07	8 17	8 29	8 43	8 59	9 18	9 43	10 18
10	7 22	7 27	7 34	7 40	7 48	7 56	8 05	8 15	8 26	8 39	8 55	9 13	9 36	10 08
14	7 20	7 26	7 32	7 39	7 46	7 53	8 02	8 12	8 22	8 35	8 49	9 07	9 28	9 56
18	7 19	7 24	7 30	7 36	7 43	7 50	7 58	8 08	8 18	8 29	8 43	8 59	9 19	9 44
22	7 17	7 22	7 27	7 33	7 39	7 46	7 54	8 03	8 12	8 23	8 36	8 50	9 08	9 31
26	7 14	7 19	7 24	7 29	7 35	7 42	7 49	7 57	8 06	8 16	8 28	8 41	8 57	9 17
30	7 11	7 15	7 20	7 25	7 31	7 37	7 43	7 51	7 59	8 08	8 19	8 31	8 46	9 04
Feb. 3	7 07	7 11	7 15	7 20	7 25	7 31	7 37	7 44	7 51	8 00	8 09	8 21	8 34	8 49
7	7 03	7 06	7 10	7 15	7 20	7 25	7 30	7 36	7 43	7 51	7 59	8 09	8 21	8 35
11	6 58	7 01	7 05	7 09	7 13	7 18	7 23	7 28	7 35	7 41	7 49	7 58	8 08	8 21
15	6 53	6 56	6 59	7 03	7 07	7 11	7 15	7 20	7 26	7 32	7 38	7 46	7 55	8 06
19	6 48	6 51	6 53	6 57	7 00	7 03	7 07	7 12	7 16	7 22	7 27	7 34	7 42	7 51
23	6 42	6 45	6 47	6 50	6 53	6 56	6 59	7 03	7 07	7 11	7 16	7 22	7 28	7 36
27	6 37	6 39	6 41	6 43	6 45	6 48	6 51	6 54	6 57	7 01	7 05	7 09	7 15	7 21
Mar. 3	6 31	6 32	6 34	6 36	6 38	6 40	6 42	6 44	6 47	6 50	6 53	6 57	7 01	7 06
7	6 25	6 26	6 27	6 28	6 30	6 31	6 33	6 35	6 37	6 39	6 41	6 44	6 47	6 51
11	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	6 28	6 29	6 31	6 33	6 36
15	6 12	6 12	6 13	6 13	6 14	6 14	6 15	6 15	6 16	6 17	6 17	6 18	6 19	6 20
19	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05	6 05
23	5 59	5 59	5 58	5 58	5 57	5 57	5 56	5 56	5 55	5 54	5 53	5 52	5 51	5 50
27	5 52	5 52	5 51	5 50	5 49	5 48	5 47	5 46	5 44	5 43	5 41	5 39	5 37	5 34
31	5 46	5 45	5 44	5 42	5 41	5 39	5 38	5 36	5 34	5 31	5 29	5 26	5 23	5 19
Apr. 4	5 40	5 38	5 36	5 35	5 33	5 31	5 28	5 26	5 23	5 20	5 17	5 13	5 08	5 03

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. -2	16 43	16 37	16 30	16 23	16 15	16 06	15 56	15 45	15 33	15 18	15 01	14 40	14 13	13 32
2	16 46	16 40	16 33	16 26	16 18	16 10	16 00	15 49	15 37	15 23	15 06	14 46	14 20	13 42
6	16 50	16 44	16 37	16 30	16 23	16 14	16 05	15 55	15 43	15 29	15 13	14 54	14 29	13 54
10	16 54	16 48	16 42	16 35	16 27	16 19	16 10	16 00	15 49	15 36	15 21	15 02	14 39	14 08
14	16 58	16 52	16 46	16 40	16 33	16 25	16 16	16 07	15 56	15 44	15 29	15 12	14 51	14 23
18	17 02	16 57	16 51	16 45	16 38	16 31	16 23	16 14	16 04	15 52	15 38	15 22	15 03	14 38
22	17 07	17 02	16 56	16 51	16 44	16 37	16 30	16 21	16 12	16 01	15 48	15 33	15 15	14 53
26	17 12	17 07	17 02	16 56	16 50	16 44	16 37	16 29	16 20	16 10	15 58	15 45	15 29	15 08
30	17 16	17 12	17 07	17 02	16 57	16 51	16 44	16 37	16 28	16 19	16 09	15 56	15 42	15 24
Feb. 3	17 21	17 17	17 13	17 08	17 03	16 57	16 51	16 45	16 37	16 29	16 19	16 08	15 55	15 39
7	17 26	17 22	17 18	17 14	17 09	17 04	16 59	16 53	16 46	16 38	16 30	16 20	16 08	15 54
11	17 31	17 27	17 24	17 20	17 16	17 11	17 06	17 01	16 55	16 48	16 40	16 31	16 21	16 09
15	17 36	17 33	17 29	17 26	17 22	17 18	17 14	17 09	17 03	16 58	16 51	16 43	16 34	16 24
19	17 40	17 38	17 35	17 32	17 28	17 25	17 21	17 17	17 12	17 07	17 01	16 55	16 47	16 38
23	17 45	17 43	17 40	17 38	17 35	17 32	17 28	17 25	17 21	17 17	17 12	17 06	17 00	16 52
27	17 49	17 47	17 45	17 43	17 41	17 38	17 36	17 33	17 30	17 26	17 22	17 17	17 12	17 06
Mar. 3	17 54	17 52	17 51	17 49	17 47	17 45	17 43	17 41	17 38	17 35	17 32	17 28	17 24	17 19
7	17 58	17 57	17 56	17 55	17 53	17 52	17 50	17 48	17 46	17 44	17 42	17 39	17 36	17 33
11	18 02	18 02	18 01	18 00	17 59	17 58	17 57	17 56	17 55	17 53	17 52	17 50	17 48	17 46
15	18 07	18 06	18 06	18 06	18 05	18 05	18 04	18 04	18 03	18 03	18 02	18 01	18 00	17 59
19	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 11	18 12	18 12	18 12	18 12	18 12
23	18 15	18 15	18 16	18 16	18 17	18 17	18 18	18 19	18 20	18 20	18 22	18 23	18 24	18 26
27	18 19	18 20	18 21	18 22	18 23	18 24	18 25	18 26	18 28	18 29	18 31	18 33	18 36	18 39
31	18 23	18 24	18 26	18 27	18 28	18 30	18 32	18 34	18 36	18 38	18 41	18 44	18 48	18 52
Apr. 4	18 27	18 29	18 30	18 32	18 34	18 36	18 39	18 41	18 44	18 47	18 51	18 55	18 59	19 05

SUNRISE AND SUNSET, 2010

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	6 22	6 19	6 16	6 14	6 12	6 10	6 07	6 04	6 01	5 58	5 55	5 51	5 49	5 46
Apr. 4	6 30	6 25	6 21	6 18	6 15	6 12	6 08	6 04	6 00	5 56	5 51	5 46	5 43	5 40
8	6 37	6 31	6 26	6 22	6 18	6 15	6 09	6 04	5 59	5 53	5 48	5 41	5 38	5 33
12	6 45	6 37	6 31	6 26	6 21	6 17	6 10	6 04	5 57	5 51	5 45	5 37	5 32	5 27
16	6 53	6 44	6 36	6 30	6 24	6 20	6 11	6 04	5 56	5 49	5 41	5 32	5 27	5 21
20	7 00	6 50	6 41	6 34	6 28	6 22	6 12	6 04	5 56	5 47	5 38	5 28	5 22	5 15
24	7 08	6 56	6 46	6 38	6 31	6 24	6 14	6 04	5 55	5 46	5 36	5 24	5 17	5 10
28	7 16	7 02	6 51	6 42	6 34	6 27	6 15	6 04	5 54	5 44	5 33	5 20	5 13	5 04
May 2	7 23	7 08	6 56	6 46	6 37	6 29	6 16	6 05	5 54	5 42	5 30	5 16	5 08	4 59
6	7 30	7 14	7 01	6 50	6 40	6 32	6 18	6 05	5 53	5 41	5 28	5 13	5 04	4 54
10	7 38	7 19	7 05	6 53	6 43	6 35	6 19	6 06	5 53	5 40	5 26	5 10	5 01	4 50
14	7 44	7 25	7 10	6 57	6 46	6 37	6 21	6 06	5 53	5 39	5 24	5 07	4 57	4 46
18	7 51	7 31	7 14	7 01	6 50	6 40	6 22	6 07	5 53	5 38	5 23	5 05	4 54	4 42
22	7 58	7 36	7 18	7 04	6 52	6 42	6 24	6 08	5 53	5 38	5 22	5 03	4 52	4 39
26	8 04	7 40	7 22	7 08	6 55	6 44	6 25	6 09	5 53	5 38	5 21	5 01	4 50	4 36
30	8 09	7 45	7 26	7 11	6 58	6 47	6 27	6 10	5 54	5 38	5 20	5 00	4 48	4 34
June 3	8 14	7 49	7 29	7 14	7 00	6 49	6 29	6 11	5 54	5 38	5 20	4 59	4 47	4 33
7	8 18	7 52	7 32	7 16	7 02	6 51	6 30	6 12	5 55	5 38	5 20	4 58	4 46	4 31
11	8 22	7 55	7 35	7 18	7 04	6 52	6 31	6 13	5 56	5 39	5 20	4 58	4 45	4 31
15	8 24	7 57	7 37	7 20	7 06	6 54	6 33	6 14	5 57	5 39	5 20	4 58	4 46	4 31
19	8 26	7 59	7 38	7 21	7 07	6 55	6 34	6 15	5 58	5 40	5 21	4 59	4 46	4 31
23	8 27	8 00	7 39	7 22	7 08	6 56	6 35	6 16	5 59	5 41	5 22	5 00	4 47	4 32
27	8 27	8 00	7 40	7 23	7 09	6 56	6 35	6 17	5 59	5 42	5 23	5 01	4 48	4 33
July 1	8 26	8 00	7 39	7 23	7 09	6 57	6 36	6 17	6 00	5 43	5 24	5 02	4 50	4 35
5	8 24	7 58	7 38	7 22	7 08	6 56	6 36	6 18	6 01	5 44	5 25	5 04	4 51	4 37

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	17 45	17 49	17 52	17 54	17 56	17 58	18 01	18 04	18 07	18 11	18 14	18 18	18 20	18 23
Apr. 4	17 35	17 40	17 44	17 48	17 51	17 53	17 58	18 02	18 06	18 10	18 15	18 20	18 24	18 27
8	17 25	17 32	17 37	17 41	17 45	17 49	17 55	18 00	18 05	18 10	18 16	18 23	18 27	18 31
12	17 16	17 23	17 30	17 35	17 40	17 44	17 51	17 58	18 04	18 10	18 17	18 25	18 30	18 35
16	17 06	17 15	17 23	17 29	17 35	17 40	17 48	17 56	18 03	18 11	18 19	18 28	18 33	18 39
20	16 57	17 07	17 16	17 24	17 30	17 35	17 45	17 54	18 02	18 11	18 20	18 30	18 36	18 43
24	16 47	17 00	17 10	17 18	17 25	17 31	17 42	17 52	18 02	18 11	18 21	18 33	18 40	18 47
28	16 39	16 52	17 04	17 13	17 21	17 28	17 40	17 51	18 01	18 11	18 22	18 35	18 43	18 51
May 2	16 30	16 45	16 58	17 08	17 16	17 24	17 37	17 49	18 00	18 12	18 24	18 38	18 46	18 55
6	16 22	16 39	16 52	17 03	17 13	17 21	17 35	17 48	18 00	18 12	18 25	18 40	18 49	18 59
10	16 15	16 33	16 47	16 59	17 09	17 18	17 33	17 47	18 00	18 13	18 27	18 43	18 53	19 03
14	16 08	16 27	16 42	16 55	17 06	17 15	17 32	17 46	18 00	18 14	18 28	18 46	18 56	19 07
18	16 01	16 22	16 38	16 52	17 03	17 13	17 30	17 46	18 00	18 14	18 30	18 48	18 59	19 11
22	15 55	16 17	16 34	16 49	17 01	17 11	17 29	17 45	18 00	18 15	18 32	18 51	19 02	19 15
26	15 50	16 13	16 31	16 46	16 59	17 10	17 28	17 45	18 01	18 16	18 33	18 53	19 05	19 18
30	15 46	16 10	16 29	16 44	16 57	17 08	17 28	17 45	18 01	18 17	18 35	18 55	19 07	19 21
June 3	15 42	16 07	16 27	16 42	16 56	17 07	17 28	17 45	18 02	18 18	18 37	18 57	19 10	19 24
7	15 39	16 05	16 25	16 41	16 55	17 07	17 28	17 46	18 02	18 20	18 38	18 59	19 12	19 27
11	15 37	16 04	16 24	16 41	16 55	17 07	17 28	17 46	18 03	18 21	18 39	19 01	19 14	19 29
15	15 36	16 03	16 24	16 41	16 55	17 07	17 28	17 47	18 04	18 22	18 41	19 03	19 15	19 30
19	15 36	16 04	16 24	16 41	16 55	17 08	17 29	17 48	18 05	18 23	18 42	19 04	19 17	19 32
23	15 37	16 04	16 25	16 42	16 56	17 09	17 30	17 48	18 06	18 23	18 42	19 05	19 18	19 33
27	15 39	16 06	16 27	16 43	16 57	17 10	17 31	17 49	18 07	18 24	18 43	19 05	19 18	19 33
July 1	15 42	16 08	16 29	16 45	16 59	17 11	17 32	17 50	18 08	18 25	18 43	19 05	19 18	19 33
5	15 45	16 11	16 31	16 47	17 01	17 13	17 33	17 51	18 08	18 25	18 44	19 05	19 18	19 32

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	5 46	5 45	5 44	5 42	5 41	5 39	5 38	5 36	5 34	5 31	5 29	5 26	5 23	5 19
Apr. 4	5 40	5 38	5 36	5 35	5 33	5 31	5 28	5 26	5 23	5 20	5 17	5 13	5 08	5 03
8	5 33	5 31	5 29	5 27	5 25	5 22	5 19	5 16	5 13	5 09	5 05	5 00	4 54	4 48
12	5 27	5 25	5 22	5 20	5 17	5 14	5 10	5 07	5 03	4 58	4 53	4 47	4 40	4 32
16	5 21	5 18	5 16	5 12	5 09	5 06	5 02	4 57	4 52	4 47	4 41	4 34	4 26	4 17
20	5 15	5 12	5 09	5 05	5 02	4 58	4 53	4 48	4 43	4 36	4 29	4 21	4 12	4 01
24	5 10	5 06	5 03	4 59	4 54	4 50	4 45	4 39	4 33	4 26	4 18	4 09	3 58	3 45
28	5 04	5 00	4 56	4 52	4 47	4 42	4 37	4 30	4 23	4 16	4 07	3 56	3 44	3 30
May 2	4 59	4 55	4 51	4 46	4 41	4 35	4 29	4 22	4 14	4 06	3 56	3 44	3 31	3 14
6	4 54	4 50	4 45	4 40	4 34	4 28	4 21	4 14	4 06	3 56	3 45	3 32	3 17	2 58
10	4 50	4 45	4 40	4 34	4 28	4 22	4 14	4 06	3 57	3 47	3 35	3 21	3 04	2 43
14	4 46	4 41	4 35	4 29	4 23	4 16	4 08	3 59	3 49	3 38	3 25	3 10	2 51	2 27
18	4 42	4 37	4 31	4 25	4 18	4 10	4 02	3 53	3 42	3 30	3 16	2 59	2 38	2 11
22	4 39	4 33	4 27	4 21	4 13	4 05	3 57	3 47	3 35	3 23	3 07	2 49	2 26	1 55
26	4 36	4 31	4 24	4 17	4 10	4 01	3 52	3 41	3 30	3 16	3 00	2 40	2 14	1 38
30	4 34	4 28	4 21	4 14	4 06	3 58	3 48	3 37	3 24	3 10	2 53	2 31	2 03	1 21
June 3	4 33	4 26	4 19	4 12	4 04	3 55	3 45	3 33	3 20	3 05	2 47	2 24	1 53	1 04
7	4 31	4 25	4 18	4 10	4 02	3 52	3 42	3 30	3 17	3 01	2 42	2 18	1 45	0 45
11	4 31	4 24	4 17	4 09	4 00	3 51	3 40	3 28	3 14	2 58	2 38	2 13	1 38	0 22
15	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 10	1 33	□
19	4 31	4 24	4 17	4 09	4 00	3 50	3 39	3 27	3 13	2 56	2 36	2 09	1 31	□
23	4 32	4 25	4 18	4 10	4 01	3 51	3 40	3 28	3 14	2 57	2 36	2 10	1 32	□
27	4 33	4 26	4 19	4 11	4 02	3 53	3 42	3 30	3 15	2 59	2 38	2 12	1 35	□
July 1	4 35	4 28	4 21	4 13	4 04	3 55	3 44	3 32	3 18	3 02	2 42	2 17	1 41	0 18
5	4 37	4 30	4 23	4 15	4 07	3 58	3 47	3 35	3 22	3 06	2 47	2 22	1 49	0 46

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 31	18 23	18 24	18 26	18 27	18 28	18 30	18 32	18 34	18 36	18 38	18 41	18 44	18 48	18 52
Apr. 4	18 27	18 29	18 30	18 32	18 34	18 36	18 39	18 41	18 44	18 47	18 51	18 55	18 59	19 05
8	18 31	18 33	18 35	18 37	18 40	18 43	18 45	18 49	18 52	18 56	19 01	19 06	19 11	19 18
12	18 35	18 38	18 40	18 43	18 46	18 49	18 52	18 56	19 00	19 05	19 10	19 16	19 23	19 32
16	18 39	18 42	18 45	18 48	18 51	18 55	18 59	19 04	19 09	19 14	19 20	19 27	19 36	19 45
20	18 43	18 46	18 50	18 53	18 57	19 01	19 06	19 11	19 17	19 23	19 30	19 38	19 48	19 59
24	18 47	18 51	18 55	18 59	19 03	19 08	19 13	19 19	19 25	19 32	19 40	19 49	20 00	20 13
28	18 51	18 55	18 59	19 04	19 09	19 14	19 20	19 26	19 33	19 41	19 50	20 01	20 13	20 28
May 2	18 55	19 00	19 04	19 09	19 14	19 20	19 26	19 33	19 41	19 50	20 00	20 12	20 26	20 43
6	18 59	19 04	19 09	19 14	19 20	19 26	19 33	19 41	19 49	19 59	20 10	20 23	20 39	20 58
10	19 03	19 08	19 14	19 19	19 25	19 32	19 39	19 48	19 57	20 07	20 20	20 34	20 51	21 13
14	19 07	19 12	19 18	19 24	19 31	19 38	19 46	19 55	20 05	20 16	20 29	20 45	21 04	21 29
18	19 11	19 17	19 22	19 29	19 36	19 43	19 52	20 01	20 12	20 24	20 39	20 56	21 17	21 46
22	19 15	19 20	19 27	19 33	19 41	19 49	19 58	20 08	20 19	20 32	20 48	21 06	21 30	22 02
26	19 18	19 24	19 30	19 37	19 45	19 54	20 03	20 14	20 26	20 39	20 56	21 16	21 42	22 20
30	19 21	19 27	19 34	19 41	19 49	19 58	20 08	20 19	20 32	20 46	21 04	21 25	21 54	22 38
June 3	19 24	19 30	19 37	19 45	19 53	20 02	20 12	20 24	20 37	20 52	21 11	21 34	22 05	22 56
7	19 27	19 33	19 40	19 48	19 56	20 06	20 16	20 28	20 42	20 57	21 17	21 41	22 15	23 17
11	19 29	19 35	19 43	19 50	19 59	20 09	20 19	20 31	20 45	21 02	21 22	21 47	22 23	23 46
15	19 30	19 37	19 45	19 53	20 01	20 11	20 22	20 34	20 48	21 05	21 25	21 51	22 29	□
19	19 32	19 39	19 46	19 54	20 03	20 12	20 23	20 36	20 50	21 07	21 27	21 54	22 32	□
23	19 33	19 39	19 47	19 55	20 04	20 13	20 24	20 36	20 51	21 08	21 28	21 54	22 32	□
27	19 33	19 40	19 47	19 55	20 04	20 13	20 24	20 36	20 50	21 07	21 27	21 53	22 30	□
July 1	19 33	19 39	19 47	19 54	20 03	20 13	20 23	20 35	20 49	21 05	21 25	21 50	22 25	23 41
5	19 32	19 39	19 46	19 53	20 02	20 11	20 21	20 33	20 47	21 02	21 21	21 46	22 19	23 18

□ indicates Sun continuously above horizon.

SUNRISE AND SUNSET, 2010
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.		-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0	+10°	+20°	+30°	+35°	+40°
		h	m	h	m	h	m	h	m	h	m	h	m	h	m
July	1	8	26	8	00	7	39	7	23	7	09	6	57	6	35
	5	8	24	7	58	7	38	7	22	7	08	6	56	6	36
	9	8	21	7	56	7	37	7	21	7	08	6	56	6	36
	13	8	18	7	53	7	35	7	19	7	06	6	55	6	35
	17	8	13	7	50	7	32	7	17	7	05	6	54	6	35
	21	8	08	7	46	7	29	7	15	7	03	6	52	6	34
	25	8	02	7	41	7	25	7	11	7	00	6	50	6	33
	29	7	55	7	36	7	21	7	08	6	57	6	48	6	31
	Aug. 2	7	48	7	30	7	16	7	04	6	54	6	45	6	29
	6	7	41	7	24	7	11	7	00	6	50	6	42	6	27
	10	7	33	7	17	7	05	6	55	6	46	6	38	6	25
	14	7	24	7	10	6	59	6	50	6	42	6	35	6	22
	18	7	15	7	03	6	53	6	44	6	37	6	31	6	20
	22	7	06	6	55	6	46	6	39	6	32	6	27	6	17
	26	6	57	6	47	6	39	6	33	6	27	6	22	6	14
	30	6	47	6	39	6	32	6	27	6	22	6	18	6	10
	Sept. 3	6	37	6	31	6	25	6	21	6	17	6	13	6	07
	7	6	27	6	22	6	18	6	14	6	11	6	08	6	03
	11	6	17	6	13	6	10	6	08	6	06	6	03	6	00
	15	6	07	6	05	6	03	6	01	6	00	5	59	5	56
	19	5	57	5	56	5	55	5	55	5	54	5	54	5	53
	23	5	46	5	47	5	48	5	48	5	49	5	49	5	49
	27	5	36	5	38	5	40	5	41	5	43	5	44	5	45
	Oct. 1	5	26	5	30	5	32	5	35	5	37	5	39	5	42
	5	5	16	5	21	5	25	5	28	5	31	5	34	5	38

SUNSET

		h	m	h	m	h	m	h	m	h	m	h	m	h	m
July	1	15	42	16	08	16	29	16	45	16	59	17	11	17	32
	5	15	45	16	11	16	31	16	47	17	01	17	13	17	33
	9	15	49	16	15	16	34	16	50	17	03	17	15	17	35
	13	15	54	16	18	16	37	16	52	17	05	17	17	17	36
	17	16	00	16	23	16	41	16	55	17	08	17	19	17	38
	21	16	05	16	27	16	45	16	59	17	11	17	21	17	39
	25	16	12	16	32	16	49	17	02	17	13	17	23	17	41
	29	16	18	16	37	16	53	17	05	17	16	17	26	17	42
	Aug. 2	16	25	16	43	16	57	17	09	17	19	17	28	17	43
	6	16	32	16	48	17	02	17	13	17	22	17	30	17	45
	10	16	39	16	54	17	06	17	16	17	25	17	33	17	46
	14	16	46	17	00	17	11	17	20	17	28	17	35	17	47
	18	16	53	17	06	17	16	17	24	17	31	17	37	17	48
	22	17	01	17	11	17	20	17	28	17	34	17	39	17	49
	26	17	08	17	17	17	25	17	31	17	37	17	42	17	50
	30	17	15	17	23	17	30	17	35	17	40	17	44	17	51
	Sept. 3	17	22	17	29	17	34	17	39	17	43	17	46	17	52
	7	17	30	17	35	17	39	17	42	17	45	17	48	17	53
	11	17	37	17	41	17	44	17	46	17	48	17	50	17	54
	15	17	45	17	47	17	48	17	50	17	51	17	52	17	55
	19	17	52	17	53	17	53	17	54	17	54	17	55	17	55
	23	17	59	17	59	17	58	17	57	17	57	17	56	17	56
	27	18	07	18	05	18	03	18	01	18	00	17	59	17	57
	Oct. 1	18	15	18	11	18	08	18	05	18	03	18	01	17	58
	5	18	22	18	17	18	13	18	09	18	06	18	04	17	59

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July	1	4 35	4 28	4 21	4 13	4 04	3 55	3 44	3 32	3 18	3 02	2 42	2 17	1 41
	5	4 37	4 30	4 23	4 15	4 07	3 58	3 47	3 35	3 22	3 06	2 47	2 22	1 49
	9	4 39	4 33	4 26	4 18	4 10	4 01	3 51	3 40	3 26	3 11	2 53	2 30	1 58
	13	4 42	4 36	4 29	4 22	4 14	4 05	3 55	3 44	3 32	3 17	3 00	2 38	2 09
	17	4 45	4 39	4 33	4 26	4 18	4 10	4 00	3 50	3 38	3 24	3 07	2 47	2 21
	21	4 48	4 43	4 36	4 30	4 22	4 14	4 05	3 55	3 44	3 31	3 15	2 57	2 33
	25	4 52	4 46	4 40	4 34	4 27	4 19	4 11	4 02	3 51	3 39	3 24	3 07	2 45
	29	4 55	4 50	4 45	4 39	4 32	4 25	4 17	4 08	3 58	3 47	3 33	3 17	2 58
	Aug.	2	4 59	4 54	4 49	4 43	4 37	4 30	4 23	4 15	4 05	3 55	3 43	3 28
		6	5 03	4 58	4 53	4 48	4 42	4 36	4 29	4 22	4 13	4 03	3 52	3 39
	10	5 07	5 02	4 58	4 53	4 48	4 42	4 36	4 29	4 21	4 12	4 02	3 50	3 36
	14	5 10	5 07	5 02	4 58	4 53	4 48	4 42	4 36	4 29	4 21	4 11	4 01	3 48
	18	5 14	5 11	5 07	5 03	4 59	4 54	4 49	4 43	4 36	4 29	4 21	4 12	4 01
	22	5 18	5 15	5 12	5 08	5 04	5 00	4 55	4 50	4 44	4 38	4 31	4 22	4 13
	26	5 22	5 19	5 16	5 13	5 09	5 06	5 02	4 57	4 52	4 47	4 40	4 33	4 25
	30	5 26	5 23	5 21	5 18	5 15	5 12	5 08	5 04	5 00	4 55	4 50	4 43	4 36
	Sept.	3	5 29	5 27	5 25	5 23	5 20	5 18	5 15	5 11	5 08	5 04	4 59	4 54
		7	5 33	5 32	5 30	5 28	5 26	5 24	5 21	5 19	5 16	5 12	5 09	5 04
	11	5 37	5 36	5 34	5 33	5 31	5 30	5 28	5 26	5 23	5 21	5 18	5 15	5 11
		15	5 41	5 40	5 39	5 38	5 37	5 36	5 34	5 33	5 31	5 29	5 27	5 25
	19	5 44	5 44	5 43	5 43	5 42	5 42	5 41	5 40	5 39	5 38	5 37	5 35	5 34
	23	5 48	5 48	5 48	5 48	5 48	5 48	5 47	5 47	5 47	5 46	5 46	5 45	5 45
	27	5 52	5 52	5 53	5 53	5 53	5 54	5 54	5 54	5 55	5 55	5 56	5 56	5 57
	Oct.	1	5 56	5 57	5 57	5 58	5 59	6 00	6 01	6 01	6 03	6 04	6 05	6 06
		5	6 00	6 01	6 02	6 03	6 04	6 06	6 07	6 09	6 11	6 12	6 15	6 17

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July	1	19 33	19 39	19 47	19 54	20 03	20 13	20 23	20 35	20 49	21 05	21 25	21 50	22 25
	5	19 32	19 39	19 46	19 53	20 02	20 11	20 21	20 33	20 47	21 02	21 21	21 46	22 19
	9	19 31	19 37	19 44	19 52	20 00	20 09	20 19	20 30	20 43	20 58	21 17	21 39	22 10
	13	19 29	19 35	19 42	19 49	19 57	20 06	20 15	20 26	20 39	20 53	21 11	21 32	22 00
	17	19 27	19 33	19 39	19 46	19 54	20 02	20 11	20 22	20 34	20 47	21 04	21 24	21 49
	21	19 24	19 30	19 36	19 42	19 50	19 58	20 07	20 16	20 28	20 41	20 56	21 14	21 37
	25	19 21	19 26	19 32	19 38	19 45	19 53	20 01	20 10	20 21	20 33	20 47	21 04	21 25
	29	19 17	19 22	19 28	19 34	19 40	19 47	19 55	20 04	20 14	20 25	20 38	20 54	21 13
	Aug.	2	19 13	19 18	19 23	19 28	19 35	19 41	19 49	19 57	20 06	20 16	20 28	20 59
		6	19 08	19 13	19 18	19 23	19 29	19 35	19 41	19 49	19 57	20 07	20 18	20 46
	10	19 04	19 08	19 12	19 17	19 22	19 28	19 34	19 41	19 49	19 57	20 07	20 19	20 33
	14	18 58	19 02	19 06	19 11	19 15	19 21	19 26	19 32	19 39	19 47	19 56	20 07	20 19
	18	18 53	18 56	19 00	19 04	19 08	19 13	19 18	19 24	19 30	19 37	19 45	19 54	20 05
	22	18 47	18 50	18 53	18 57	19 01	19 05	19 10	19 15	19 20	19 26	19 34	19 42	19 51
	26	18 41	18 44	18 47	18 50	18 53	18 57	19 01	19 05	19 10	19 16	19 22	19 29	19 37
	30	18 35	18 37	18 40	18 43	18 45	18 49	18 52	18 56	19 00	19 05	19 10	19 16	19 23
	Sept.	3	18 29	18 31	18 33	18 35	18 37	18 40	18 43	18 46	18 50	18 54	18 58	19 03
		7	18 22	18 24	18 26	18 27	18 29	18 31	18 34	18 36	18 39	18 42	18 46	18 50
	11	18 16	18 17	18 18	18 20	18 21	18 23	18 25	18 27	18 29	18 31	18 34	18 37	18 40
		15	18 09	18 10	18 11	18 12	18 13	18 14	18 15	18 17	18 18	18 20	18 22	18 24
	19	18 02	18 03	18 03	18 04	18 05	18 05	18 06	18 07	18 07	18 08	18 09	18 11	18 12
	23	17 56	17 56	17 56	17 56	17 56	17 56	17 56	17 57	17 57	17 57	17 57	17 58	17 58
	27	17 49	17 49	17 49	17 48	17 48	17 48	17 47	17 47	17 46	17 46	17 45	17 45	17 44
	Oct.	1	17 43	17 42	17 41	17 41	17 40	17 39	17 38	17 37	17 36	17 34	17 33	17 32
		5	17 36	17 35	17 34	17 33	17 32	17 30	17 29	17 27	17 25	17 23	17 21	17 19

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
SUNRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct.	1	5 26	5 30	5 32	5 35	5 37	5 39	5 42	5 44	5 46	5 49	5 51	5 53	5 56
	5	5 16	5 21	5 25	5 28	5 31	5 34	5 38	5 42	5 45	5 48	5 52	5 56	6 00
	9	5 06	5 12	5 18	5 22	5 26	5 29	5 35	5 40	5 44	5 48	5 53	5 58	6 04
	13	4 56	5 04	5 10	5 16	5 20	5 24	5 31	5 37	5 43	5 48	5 54	6 00	6 08
	17	4 46	4 56	5 03	5 10	5 15	5 20	5 28	5 35	5 42	5 49	5 55	6 03	6 12
	21	4 36	4 47	4 56	5 04	5 10	5 16	5 25	5 34	5 41	5 49	5 57	6 06	6 17
	25	4 27	4 40	4 50	4 58	5 06	5 12	5 23	5 32	5 41	5 49	5 58	6 09	6 21
	29	4 18	4 32	4 44	4 53	5 01	5 08	5 20	5 31	5 40	5 50	6 00	6 11	6 25
	Nov.	2	4 09	4 25	4 38	4 48	4 57	5 05	5 18	5 29	5 40	5 51	6 02	6 30
		6	4 01	4 18	4 32	4 43	4 53	5 02	5 16	5 29	5 40	5 52	6 04	6 35
	10	3 53	4 12	4 27	4 39	4 50	4 59	5 14	5 28	5 40	5 53	6 06	6 21	6 39
	14	3 46	4 06	4 22	4 36	4 47	4 57	5 13	5 28	5 41	5 54	6 08	6 24	6 44
	18	3 39	4 01	4 18	4 32	4 44	4 55	5 12	5 27	5 42	5 56	6 10	6 27	6 48
	22	3 33	3 56	4 15	4 30	4 42	4 53	5 12	5 28	5 42	5 57	6 13	6 31	6 53
	26	3 27	3 53	4 12	4 27	4 41	4 52	5 11	5 28	5 44	5 59	6 15	6 34	6 57
Dec.	30	3 23	3 49	4 10	4 26	4 39	4 51	5 11	5 29	5 45	6 01	6 18	6 37	7 01
	4	3 20	3 47	4 08	4 25	4 39	4 51	5 12	5 30	5 46	6 03	6 20	6 40	7 05
	8	3 17	3 46	4 07	4 24	4 39	4 52	5 13	5 31	5 48	6 05	6 23	6 43	7 09
	12	3 16	3 45	4 07	4 25	4 39	4 52	5 14	5 33	5 50	6 07	6 25	6 46	7 12
	16	3 15	3 45	4 08	4 26	4 41	4 53	5 15	5 34	5 52	6 09	6 28	6 49	7 15
	20	3 16	3 46	4 09	4 27	4 42	4 55	5 17	5 36	5 54	6 11	6 30	6 51	7 18
	24	3 18	3 48	4 11	4 29	4 44	4 57	5 19	5 38	5 56	6 13	6 32	6 53	7 20
	28	3 21	3 51	4 14	4 32	4 47	4 59	5 21	5 40	5 58	6 15	6 34	6 55	7 21
	32	3 26	3 55	4 17	4 35	4 49	5 02	5 24	5 42	6 00	6 17	6 35	6 56	7 22
	36	3 31	3 59	4 21	4 38	4 53	5 05	5 26	5 45	6 02	6 18	6 36	6 57	7 22

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct.	1	18 15	18 11	18 08	18 05	18 03	18 01	17 58	17 55	17 53	17 51	17 48	17 46	17 43
	5	18 22	18 17	18 13	18 09	18 06	18 04	17 59	17 55	17 52	17 48	17 45	17 41	17 36
	9	18 30	18 23	18 18	18 13	18 09	18 06	18 00	17 55	17 51	17 46	17 41	17 36	17 30
	13	18 38	18 30	18 23	18 18	18 13	18 09	18 01	17 55	17 50	17 44	17 38	17 32	17 24
	17	18 46	18 36	18 28	18 22	18 16	18 11	18 03	17 55	17 49	17 42	17 35	17 27	17 18
	21	18 54	18 43	18 34	18 26	18 20	18 14	18 04	17 56	17 48	17 40	17 32	17 23	17 12
	25	19 03	18 50	18 39	18 31	18 23	18 17	18 06	17 56	17 47	17 39	17 30	17 19	17 07
	29	19 11	18 56	18 45	18 35	18 27	18 20	18 08	17 57	17 47	17 37	17 27	17 16	17 02
	Nov.	2	19 19	19 03	18 50	18 40	18 31	18 23	18 09	17 58	17 47	17 36	17 25	17 12
		6	19 28	19 10	18 56	18 44	18 35	18 26	18 11	17 59	17 47	17 36	17 23	17 09
	10	19 36	19 17	19 02	18 49	18 39	18 29	18 14	18 00	17 47	17 35	17 22	17 07	16 58
	14	19 45	19 24	19 07	18 54	18 43	18 33	18 16	18 01	17 48	17 35	17 21	17 04	16 55
	18	19 53	19 30	19 13	18 59	18 47	18 36	18 18	18 03	17 49	17 35	17 20	17 03	16 53
	22	20 01	19 37	19 18	19 03	18 50	18 40	18 21	18 05	17 50	17 35	17 19	17 01	16 51
	26	20 08	19 43	19 23	19 08	18 54	18 43	18 23	18 07	17 51	17 35	17 19	17 00	16 49
Dec.	30	20 15	19 48	19 28	19 12	18 58	18 46	18 26	18 08	17 52	17 36	17 19	17 00	16 48
	4	20 22	19 54	19 33	19 16	19 02	18 49	18 28	18 11	17 54	17 37	17 20	17 00	16 48
	8	20 27	19 59	19 37	19 20	19 05	18 52	18 31	18 13	17 56	17 39	17 21	17 00	16 48
	12	20 32	20 03	19 41	19 23	19 08	18 55	18 33	18 15	17 57	17 40	17 22	17 01	16 49
	16	20 36	20 06	19 44	19 26	19 11	18 58	18 36	18 17	17 59	17 42	17 23	17 02	16 50
	20	20 39	20 09	19 46	19 28	19 13	19 00	18 38	18 19	18 01	17 44	17 25	17 04	16 52
	24	20 41	20 11	19 48	19 30	19 15	19 02	18 40	18 21	18 03	17 46	17 27	17 06	16 54
	28	20 41	20 12	19 49	19 31	19 16	19 03	18 42	18 23	18 05	17 48	17 30	17 08	16 56
	32	20 41	20 12	19 50	19 32	19 17	19 05	18 43	18 24	18 07	17 50	17 32	17 11	16 59
	36	20 39	20 11	19 49	19 32	19 18	19 05	18 44	18 26	18 09	17 52	17 34	17 14	16 49

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

SUNRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	5 56	5 57	5 57	5 58	5 59	6 00	6 01	6 01	6 03	6 04	6 05	6 06	6 08	6 10
5	6 00	6 01	6 02	6 03	6 04	6 06	6 07	6 09	6 11	6 12	6 15	6 17	6 20	6 23
9	6 04	6 05	6 07	6 09	6 10	6 12	6 14	6 16	6 19	6 21	6 24	6 28	6 31	6 36
13	6 08	6 10	6 12	6 14	6 16	6 18	6 21	6 24	6 27	6 30	6 34	6 38	6 43	6 49
17	6 12	6 14	6 17	6 19	6 22	6 25	6 28	6 31	6 35	6 39	6 44	6 49	6 55	7 02
21	6 17	6 19	6 22	6 25	6 28	6 31	6 35	6 39	6 43	6 48	6 54	7 00	7 07	7 16
25	6 21	6 24	6 27	6 30	6 34	6 38	6 42	6 47	6 52	6 57	7 04	7 11	7 20	7 30
29	6 25	6 29	6 32	6 36	6 40	6 44	6 49	6 54	7 00	7 07	7 14	7 22	7 32	7 44
Nov. 2	6 30	6 34	6 37	6 42	6 46	6 51	6 56	7 02	7 09	7 16	7 24	7 34	7 45	7 58
6	6 35	6 39	6 43	6 47	6 52	6 58	7 04	7 10	7 17	7 25	7 35	7 45	7 58	8 13
10	6 39	6 43	6 48	6 53	6 58	7 04	7 11	7 18	7 26	7 35	7 45	7 57	8 11	8 28
14	6 44	6 48	6 53	6 59	7 05	7 11	7 18	7 26	7 34	7 44	7 55	8 08	8 24	8 43
18	6 48	6 53	6 59	7 04	7 11	7 17	7 25	7 33	7 42	7 53	8 05	8 19	8 37	8 58
22	6 53	6 58	7 04	7 10	7 16	7 24	7 31	7 40	7 50	8 02	8 15	8 30	8 49	9 13
26	6 57	7 03	7 09	7 15	7 22	7 29	7 38	7 47	7 58	8 10	8 24	8 41	9 01	9 28
30	7 01	7 07	7 13	7 20	7 27	7 35	7 44	7 54	8 05	8 18	8 33	8 51	9 13	9 43
Dec. 4	7 05	7 11	7 18	7 25	7 32	7 40	7 49	8 00	8 11	8 25	8 40	9 00	9 24	9 57
8	7 09	7 15	7 22	7 29	7 37	7 45	7 54	8 05	8 17	8 31	8 47	9 08	9 33	10 09
12	7 12	7 19	7 25	7 33	7 40	7 49	7 59	8 10	8 22	8 36	8 53	9 14	9 41	10 20
16	7 15	7 22	7 28	7 36	7 44	7 53	8 02	8 13	8 26	8 41	8 58	9 19	9 47	10 29
20	7 18	7 24	7 31	7 38	7 46	7 55	8 05	8 16	8 29	8 44	9 01	9 23	9 51	10 34
24	7 20	7 26	7 33	7 40	7 48	7 57	8 07	8 18	8 31	8 46	9 03	9 25	9 53	10 36
28	7 21	7 27	7 34	7 41	7 49	7 58	8 08	8 19	8 32	8 46	9 04	9 25	9 53	10 33
32	7 22	7 28	7 35	7 42	7 50	7 59	8 08	8 19	8 31	8 46	9 02	9 23	9 50	10 28
36	7 22	7 28	7 35	7 42	7 49	7 58	8 07	8 18	8 30	8 44	9 00	9 20	9 45	10 20

SUNSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	17 43	17 42	17 41	17 41	17 40	17 39	17 38	17 37	17 36	17 34	17 33	17 32	17 30	17 28
5	17 36	17 35	17 34	17 33	17 32	17 30	17 29	17 27	17 25	17 23	17 21	17 19	17 16	17 12
9	17 30	17 29	17 27	17 25	17 24	17 22	17 20	17 17	17 15	17 12	17 09	17 06	17 02	16 57
13	17 24	17 22	17 20	17 18	17 16	17 13	17 11	17 08	17 05	17 01	16 57	16 53	16 48	16 42
17	17 18	17 16	17 13	17 11	17 08	17 05	17 02	16 59	16 55	16 51	16 46	16 40	16 34	16 27
21	17 12	17 10	17 07	17 04	17 01	16 57	16 54	16 50	16 45	16 40	16 34	16 28	16 21	16 12
25	17 07	17 04	17 01	16 57	16 54	16 50	16 45	16 41	16 36	16 30	16 23	16 16	16 07	15 57
29	17 02	16 58	16 55	16 51	16 47	16 42	16 38	16 32	16 26	16 20	16 12	16 04	15 54	15 42
Nov. 2	16 57	16 53	16 49	16 45	16 40	16 35	16 30	16 24	16 18	16 10	16 02	15 52	15 41	15 28
6	16 52	16 48	16 44	16 39	16 34	16 29	16 23	16 17	16 09	16 01	15 52	15 41	15 28	15 13
10	16 48	16 44	16 39	16 34	16 29	16 23	16 16	16 09	16 01	15 52	15 42	15 30	15 16	14 59
14	16 45	16 40	16 35	16 30	16 24	16 17	16 10	16 03	15 54	15 44	15 33	15 20	15 04	14 45
18	16 42	16 37	16 31	16 26	16 19	16 13	16 05	15 57	15 47	15 37	15 25	15 10	14 53	14 31
22	16 39	16 34	16 28	16 22	16 15	16 08	16 00	15 51	15 41	15 30	15 17	15 01	14 42	14 18
26	16 37	16 32	16 26	16 19	16 12	16 05	15 56	15 47	15 36	15 24	15 10	14 53	14 33	14 06
30	16 36	16 30	16 24	16 17	16 10	16 02	15 53	15 43	15 32	15 19	15 04	14 46	14 24	13 54
Dec. 4	16 35	16 29	16 22	16 16	16 08	16 00	15 51	15 40	15 29	15 15	14 59	14 40	14 16	13 43
8	16 35	16 28	16 22	16 15	16 07	15 58	15 49	15 38	15 26	15 12	14 56	14 36	14 10	13 34
12	16 35	16 29	16 22	16 15	16 07	15 58	15 48	15 37	15 25	15 11	14 54	14 33	14 06	13 27
16	16 36	16 30	16 23	16 15	16 07	15 58	15 49	15 38	15 25	15 10	14 53	14 32	14 04	13 22
20	16 37	16 31	16 24	16 17	16 09	16 00	15 50	15 39	15 26	15 11	14 54	14 32	14 04	13 21
24	16 39	16 33	16 26	16 19	16 11	16 02	15 52	15 41	15 28	15 13	14 56	14 34	14 06	13 24
28	16 42	16 36	16 29	16 22	16 14	16 05	15 55	15 44	15 31	15 17	15 00	14 38	14 11	13 30
32	16 45	16 39	16 32	16 25	16 17	16 08	15 59	15 48	15 36	15 22	15 05	14 44	14 17	13 39
36	16 49	16 43	16 36	16 29	16 21	16 13	16 03	15 53	15 41	15 27	15 11	14 51	14 26	13 50

MOONRISE AND MOONSET, 2010
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	20 46	20 15	19 52	19 33	19 17	19 04	18 40	18 20	18 01	17 42	17 22	16 58	16 45	16 28
1	21 18	20 54	20 36	20 20	20 07	19 56	19 37	19 20	19 04	18 48	18 31	18 11	17 59	17 46
2	21 40	21 23	21 10	20 59	20 50	20 41	20 27	20 14	20 03	19 51	19 38	19 23	19 15	19 05
3	21 56	21 46	21 38	21 32	21 26	21 21	21 12	21 05	20 57	20 50	20 42	20 33	20 28	20 22
4	22 09	22 06	22 03	22 01	21 59	21 57	21 54	21 51	21 49	21 46	21 43	21 40	21 39	21 37
5	22 21	22 24	22 26	22 28	22 29	22 31	22 33	22 36	22 38	22 40	22 42	22 45	22 46	22 48
6	22 33	22 42	22 49	22 55	23 00	23 04	23 12	23 19	23 26	23 32	23 40	23 48	23 53	23 58
7	22 47	23 02	23 13	23 23	23 32	23 39	23 52	...	...	...	...	...	...	...
8	23 04	23 25	23 41	23 54	...	...	...	0 03	0 14	0 25	0 36	0 50	0 57	1 06
9	23 26	23 53	...	...	0 06	0 16	0 33	0 49	1 03	1 17	1 33	1 51	2 02	2 14
10	23 56	...	0 13	0 30	0 44	0 57	1 18	1 36	1 54	2 11	2 30	2 51	3 04	3 19
11	...	0 28	0 52	1 11	1 27	1 41	2 05	2 26	2 45	3 05	3 26	3 50	4 04	4 21
12	0 38	1 13	1 38	1 59	2 16	2 31	2 56	3 17	3 38	3 58	4 20	4 45	5 00	5 17
13	1 32	2 06	2 32	2 52	3 09	3 23	3 48	4 09	4 29	4 49	5 10	5 35	5 50	6 06
14	2 37	3 08	3 31	3 50	4 05	4 19	4 41	5 01	5 20	5 38	5 57	6 20	6 33	6 48
15	3 49	4 14	4 34	4 50	5 03	5 15	5 34	5 51	6 07	6 23	6 40	7 00	7 11	7 24
16	5 03	5 22	5 38	5 50	6 01	6 10	6 26	6 40	6 53	7 06	7 19	7 35	7 44	7 54
17	6 16	6 30	6 41	6 50	6 58	7 05	7 16	7 26	7 36	7 45	7 55	8 07	8 13	8 21
18	7 29	7 37	7 44	7 49	7 54	7 58	8 05	8 11	8 17	8 23	8 29	8 36	8 40	8 44
19	8 41	8 44	8 46	8 48	8 49	8 51	8 53	8 55	8 57	8 59	9 01	9 04	9 05	9 07
20	9 53	9 51	9 49	9 47	9 45	9 44	9 41	9 39	9 38	9 36	9 34	9 32	9 30	9 29
21	11 07	10 59	10 52	10 47	10 42	10 38	10 31	10 25	10 19	10 13	10 07	10 00	9 56	9 52
22	12 24	12 09	11 58	11 49	11 41	11 34	11 22	11 12	11 02	10 53	10 42	10 31	10 24	10 17
23	13 43	13 23	13 07	12 54	12 42	12 33	12 16	12 02	11 49	11 35	11 21	11 05	10 56	10 46
24	15 05	14 38	14 17	14 01	13 47	13 35	13 14	12 56	12 39	12 23	12 05	11 45	11 34	11 20

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	2 28	3 03	3 29	3 50	4 07	4 21	4 46	5 08	5 28	5 47	6 09	6 33	6 47	7 04
1	3 55	4 24	4 47	5 05	5 20	5 33	5 55	6 14	6 31	6 49	7 08	7 29	7 41	7 56
2	5 30	5 52	6 10	6 24	6 35	6 46	7 03	7 18	7 32	7 46	8 01	8 18	8 27	8 39
3	7 07	7 21	7 33	7 42	7 50	7 57	8 09	8 19	8 29	8 39	8 49	9 00	9 07	9 14
4	8 40	8 48	8 53	8 58	9 02	9 06	9 12	9 17	9 22	9 27	9 32	9 38	9 41	9 45
5	10 10	10 11	10 11	10 11	10 11	10 11	10 12	10 12	10 12	10 12	10 12	10 13	10 13	10 13
6	11 37	11 31	11 26	11 22	11 18	11 15	11 10	11 05	11 01	10 56	10 51	10 46	10 43	10 40
7	13 02	12 49	12 39	12 31	12 24	12 17	12 07	11 57	11 49	11 40	11 31	11 20	11 14	11 07
8	14 25	14 06	13 51	13 39	13 28	13 19	13 04	12 50	12 37	12 25	12 11	11 56	11 47	11 37
9	15 46	15 21	15 01	14 45	14 32	14 20	14 00	13 43	13 27	13 11	12 54	12 35	12 23	12 10
10	17 02	16 31	16 08	15 49	15 33	15 20	14 57	14 37	14 18	14 00	13 40	13 17	13 04	12 49
11	18 08	17 34	17 08	16 48	16 31	16 17	15 52	15 30	15 10	14 50	14 29	14 04	13 50	13 33
12	19 02	18 27	18 02	17 41	17 24	17 09	16 44	16 23	16 03	15 42	15 21	14 56	14 41	14 23
13	19 41	19 10	18 46	18 27	18 11	17 57	17 34	17 13	16 54	16 35	16 14	15 50	15 36	15 19
14	20 09	19 43	19 23	19 06	18 52	18 40	18 19	18 00	17 43	17 26	17 07	16 46	16 33	16 18
15	20 30	20 09	19 52	19 39	19 27	19 17	18 59	18 44	18 30	18 15	17 59	17 41	17 31	17 19
16	20 45	20 30	20 17	20 07	19 58	19 50	19 37	19 25	19 14	19 03	18 50	18 37	18 28	18 19
17	20 57	20 47	20 39	20 32	20 26	20 21	20 12	20 04	19 56	19 48	19 40	19 30	19 25	19 19
18	21 07	21 02	20 58	20 55	20 52	20 49	20 45	20 40	20 37	20 33	20 28	20 24	20 21	20 18
19	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 17	21 16	21 16	21 16	21 16
20	21 27	21 32	21 36	21 39	21 42	21 45	21 49	21 53	21 57	22 01	22 05	22 10	22 12	22 15
21	21 37	21 47	21 56	22 03	22 09	22 14	22 23	22 32	22 39	22 47	22 55	23 05	23 10	23 16
22	21 50	22 06	22 19	22 29	22 38	22 46	23 00	23 12	23 24	23 35	23 48	...	...	...
23	22 07	22 29	22 46	23 01	23 13	23 23	23 41	23 57	...	...	...	0 02	0 10	0 20
24	22 31	22 59	23 21	23 39	23 53	...	...	...	0 12	0 27	0 43	1 02	1 13	1 25

... .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	16 28	16 21	16 13	16 05	15 56	15 45	15 34	15 21	15 05	14 47	14 25	13 56	13 13	□
1	17 46	17 40	17 34	17 27	17 19	17 11	17 01	16 51	16 39	16 25	16 09	15 49	15 24	14 49
2	19 05	19 01	18 56	18 51	18 46	18 40	18 33	18 26	18 18	18 08	17 58	17 45	17 30	17 12
3	20 22	20 20	20 17	20 14	20 11	20 07	20 03	19 59	19 54	19 49	19 43	19 36	19 28	19 19
4	21 37	21 36	21 35	21 34	21 33	21 32	21 30	21 29	21 27	21 26	21 24	21 21	21 19	21 16
5	22 48	22 49	22 50	22 51	22 52	22 53	22 54	22 55	22 57	22 58	23 00	23 02	23 04	23 07
6	23 58	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
7	.. ..	0 00	0 03	0 06	0 09	0 12	0 16	0 19	0 24	0 29	0 34	0 41	0 48	0 56
8	1 06	1 10	1 15	1 19	1 24	1 30	1 36	1 42	1 50	1 58	2 07	2 19	2 32	2 48
9	2 14	2 19	2 25	2 31	2 38	2 46	2 54	3 03	3 14	3 26	3 40	3 57	4 18	4 45
10	3 19	3 26	3 33	3 40	3 49	3 58	4 09	4 21	4 34	4 50	5 09	5 34	6 06	7 02
11	4 21	4 28	4 36	4 45	4 55	5 05	5 18	5 31	5 47	6 07	6 31	7 03	7 56	■
12	5 17	5 25	5 33	5 42	5 52	6 04	6 16	6 31	6 48	7 08	7 34	8 10	9 27	■
13	6 06	6 14	6 22	6 31	6 41	6 51	7 04	7 17	7 33	7 53	8 16	8 48	9 39	■
14	6 48	6 55	7 03	7 11	7 19	7 29	7 40	7 52	8 05	8 22	8 41	9 05	9 37	10 30
15	7 24	7 30	7 36	7 43	7 50	7 58	8 07	8 17	8 28	8 40	8 55	9 13	9 34	10 02
16	7 54	7 59	8 04	8 09	8 15	8 21	8 28	8 35	8 44	8 53	9 04	9 16	9 31	9 49
17	8 21	8 24	8 28	8 31	8 35	8 40	8 45	8 50	8 56	9 02	9 09	9 18	9 27	9 39
18	8 44	8 46	8 49	8 51	8 53	8 56	8 59	9 02	9 05	9 09	9 14	9 18	9 24	9 30
19	9 07	9 08	9 08	9 09	9 10	9 11	9 12	9 13	9 14	9 15	9 17	9 18	9 20	9 22
20	9 29	9 28	9 28	9 27	9 26	9 25	9 24	9 23	9 22	9 21	9 20	9 19	9 17	9 15
21	9 52	9 50	9 48	9 45	9 43	9 41	9 38	9 35	9 31	9 28	9 23	9 19	9 13	9 07
22	10 17	10 13	10 10	10 06	10 02	9 58	9 53	9 48	9 42	9 35	9 28	9 20	9 10	8 59
23	10 46	10 41	10 36	10 31	10 25	10 18	10 12	10 04	9 55	9 46	9 35	9 22	9 07	8 49
24	11 20	11 14	11 08	11 01	10 53	10 45	10 36	10 26	10 14	10 01	9 46	9 28	9 05	8 35

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 0	7 04	7 11	7 19	7 28	7 38	7 48	8 00	8 14	8 29	8 47	9 10	9 39	10 22	□
1	7 56	8 02	8 09	8 16	8 24	8 33	8 43	8 54	9 07	9 21	9 38	9 58	10 24	11 00
2	8 39	8 43	8 49	8 54	9 00	9 07	9 14	9 22	9 31	9 41	9 53	10 07	10 22	10 42
3	9 14	9 17	9 21	9 25	9 29	9 33	9 38	9 43	9 49	9 55	10 02	10 10	10 20	10 31
4	9 45	9 46	9 48	9 50	9 52	9 54	9 56	9 59	10 02	10 05	10 08	10 12	10 17	10 22
5	10 13	10 13	10 13	10 13	10 13	10 13	10 13	10 13	10 13	10 13	10 13	10 13	10 13	10 13
6	10 40	10 38	10 37	10 35	10 33	10 31	10 29	10 26	10 24	10 21	10 18	10 14	10 10	10 05
7	11 07	11 04	11 01	10 57	10 54	10 50	10 45	10 41	10 35	10 29	10 23	10 15	10 06	9 56
8	11 37	11 32	11 28	11 22	11 17	11 11	11 04	10 57	10 49	10 40	10 29	10 17	10 03	9 46
9	12 10	12 04	11 58	11 51	11 44	11 36	11 27	11 17	11 06	10 54	10 39	10 21	10 00	9 32
10	12 49	12 42	12 34	12 26	12 17	12 08	11 57	11 45	11 31	11 14	10 55	10 30	9 57	9 00
11	13 33	13 25	13 17	13 08	12 58	12 47	12 35	12 21	12 05	11 45	11 21	10 49	9 55	■
12	14 23	14 16	14 07	13 58	13 48	13 37	13 24	13 09	12 52	12 32	12 06	11 30	10 13	■
13	15 19	15 12	15 04	14 55	14 45	14 35	14 23	14 09	13 53	13 34	13 11	12 40	11 49	■
14	16 18	16 12	16 05	15 57	15 49	15 39	15 29	15 17	15 04	14 48	14 29	14 06	13 34	12 41
15	17 19	17 13	17 08	17 01	16 54	16 47	16 38	16 29	16 19	16 06	15 52	15 35	15 15	14 47
16	18 19	18 15	18 11	18 06	18 01	17 55	17 49	17 42	17 34	17 25	17 15	17 04	16 50	16 33
17	19 19	19 16	19 13	19 10	19 06	19 03	18 58	18 54	18 49	18 43	18 37	18 30	18 21	18 11
18	20 18	20 16	20 15	20 13	20 11	20 09	20 07	20 05	20 02	20 00	19 57	19 53	19 49	19 44
19	21 16	21 16	21 16	21 16	21 16	21 16	21 16	21 16	21 16	21 16	21 16	21 15	21 15	21 15
20	22 15	22 17	22 18	22 20	22 21	22 23	22 25	22 27	22 30	22 32	22 35	22 39	22 43	22 47
21	23 16	23 19	23 22	23 25	23 29	23 32	23 36	23 41	23 46	23 51	23 58	.. ..	.. ..	.. ..
22	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 05	0 13	0 23
23	0 20	0 24	0 28	0 33	0 38	0 44	0 50	0 57	1 05	1 14	1 24	1 36	1 50	2 07
24	1 25	1 31	1 37	1 43	1 51	1 58	2 07	2 17	2 27	2 40	2 55	3 12	3 34	4 03

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	13 43	13 23	13 07	12 54	12 42	12 33	12 16	12 02	11 49	11 35	11 21	11 05	10 56	10 46
24	15 05	14 38	14 17	14 01	13 47	13 35	13 14	12 56	12 39	12 23	12 05	11 45	11 34	11 20
25	16 26	15 53	15 28	15 09	14 53	14 38	14 15	13 54	13 35	13 16	12 56	12 32	12 19	12 03
26	17 38	17 02	16 36	16 15	15 58	15 43	15 17	14 55	14 35	14 15	13 53	13 28	13 13	12 56
27	18 34	18 00	17 35	17 15	16 58	16 44	16 19	15 58	15 38	15 18	14 57	14 32	14 17	14 00
28	19 13	18 46	18 24	18 07	17 52	17 40	17 18	16 59	16 41	16 23	16 04	15 42	15 29	15 14
29	19 40	19 20	19 04	18 50	18 39	18 29	18 12	17 57	17 42	17 28	17 13	16 55	16 45	16 33
30	20 00	19 46	19 36	19 27	19 19	19 12	19 01	18 50	18 40	18 31	18 20	18 08	18 01	17 53
31	20 15	20 08	20 03	19 59	19 55	19 51	19 45	19 40	19 35	19 30	19 25	19 19	19 15	19 11
Feb. 1	20 28	20 28	20 28	20 28	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27
2	20 41	20 47	20 51	20 56	20 59	21 02	21 08	21 13	21 18	21 22	21 27	21 33	21 37	21 41
3	20 54	21 06	21 16	21 24	21 32	21 38	21 49	21 58	22 08	22 17	22 27	22 38	22 45	22 52
4	21 10	21 29	21 43	21 56	22 06	22 15	22 31	22 45	22 58	23 11	23 25	23 42	23 51	...
5	21 31	21 56	22 15	22 30	22 44	22 55	23 15	23 33	23 49	...	...	...	...	0 02
6	21 59	22 29	22 52	23 10	23 26	23 39	...	...	...	0 06	0 23	0 44	0 56	1 10
7	22 37	23 11	23 36	23 56	...	...	0 02	0 22	0 41	1 00	1 20	1 44	1 58	2 14
8	23 27	...	...	...	0 13	0 27	0 52	1 14	1 34	1 54	2 15	2 40	2 55	3 12
9	...	0 01	0 27	0 47	1 04	1 19	1 44	2 06	2 26	2 46	3 07	3 32	3 47	4 04
10	0 28	1 00	1 24	1 44	2 00	2 13	2 37	2 57	3 16	3 35	3 55	4 19	4 32	4 48
11	1 38	2 05	2 26	2 43	2 57	3 09	3 30	3 48	4 05	4 21	4 39	5 00	5 12	5 26
12	2 51	3 12	3 29	3 43	3 54	4 04	4 22	4 37	4 51	5 05	5 19	5 36	5 46	5 57
13	4 04	4 20	4 33	4 43	4 51	4 59	5 12	5 24	5 34	5 45	5 56	6 09	6 17	6 25
14	5 18	5 28	5 36	5 42	5 48	5 53	6 02	6 09	6 16	6 23	6 31	6 39	6 44	6 50
15	6 30	6 35	6 38	6 41	6 44	6 46	6 50	6 54	6 57	7 00	7 04	7 08	7 10	7 12
16	7 42	7 41	7 41	7 40	7 40	7 39	7 38	7 38	7 37	7 37	7 36	7 35	7 35	7 35

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	22 07	22 29	22 46	23 01	23 13	23 23	23 41	23 57	...	...	...	0 02	0 10	0 20
24	22 31	22 59	23 21	23 39	23 53	...	...	...	0 12	0 27	0 43	1 02	1 13	1 25
25	23 07	23 41	...	...	...	0 06	0 28	0 47	1 05	1 23	1 43	2 05	2 18	2 33
26	...	...	0 06	0 26	0 43	0 57	1 22	1 43	2 03	2 23	2 44	3 09	3 24	3 40
27	0 02	0 37	1 04	1 25	1 42	1 57	2 22	2 44	3 05	3 25	3 47	4 12	4 27	4 44
28	1 17	1 50	2 15	2 34	2 50	3 04	3 28	3 49	4 08	4 27	4 47	5 11	5 24	5 40
29	2 48	3 15	3 35	3 51	4 05	4 17	4 37	4 54	5 10	5 27	5 44	6 03	6 15	6 27
30	4 26	4 45	4 59	5 11	5 21	5 30	5 45	5 58	6 10	6 22	6 35	6 49	6 58	7 07
31	6 04	6 15	6 23	6 31	6 37	6 42	6 51	6 59	7 07	7 14	7 22	7 30	7 35	7 41
Feb. 1	7 39	7 42	7 45	7 48	7 50	7 52	7 55	7 57	8 00	8 02	8 05	8 08	8 10	8 11
2	9 10	9 07	9 05	9 02	9 00	8 59	8 56	8 53	8 51	8 49	8 46	8 43	8 42	8 40
3	10 39	10 30	10 22	10 15	10 09	10 04	9 56	9 48	9 41	9 34	9 27	9 18	9 14	9 08
4	12 07	11 50	11 37	11 26	11 17	11 09	10 55	10 43	10 31	10 20	10 08	9 55	9 47	9 38
5	13 31	13 08	12 50	12 35	12 23	12 12	11 53	11 37	11 22	11 07	10 52	10 33	10 23	10 11
6	14 50	14 21	13 59	13 41	13 26	13 13	12 51	12 32	12 14	11 56	11 37	11 16	11 03	10 48
7	16 01	15 27	15 02	14 42	14 26	14 11	13 47	13 26	13 06	12 47	12 26	12 02	11 47	11 31
8	16 59	16 24	15 58	15 38	15 21	15 05	14 41	14 19	13 59	13 39	13 17	12 52	12 37	12 20
9	17 42	17 10	16 45	16 26	16 09	15 56	15 31	15 10	14 50	14 31	14 10	13 45	13 31	13 14
10	18 14	17 46	17 24	17 06	16 52	16 39	16 17	15 58	15 40	15 22	15 03	14 40	14 27	14 12
11	18 36	18 13	17 56	17 41	17 29	17 18	16 59	16 43	16 27	16 12	15 55	15 36	15 24	15 12
12	18 53	18 36	18 22	18 11	18 01	17 52	17 37	17 24	17 12	17 00	16 46	16 31	16 22	16 12
13	19 06	18 54	18 45	18 37	18 30	18 24	18 13	18 04	17 55	17 46	17 36	17 25	17 19	17 12
14	19 17	19 10	19 05	19 00	18 56	18 53	18 47	18 41	18 36	18 31	18 25	18 19	18 15	18 11
15	19 27	19 25	19 24	19 23	19 22	19 21	19 19	19 18	19 16	19 15	19 13	19 12	19 11	19 10
16	19 37	19 40	19 43	19 45	19 47	19 49	19 52	19 54	19 57	19 59	20 02	20 05	20 07	20 09

... indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	10 46	10 41	10 36	10 31	10 25	10 18	10 12	10 04	9 55	9 46	9 35	9 22	9 07	8 49
24	11 20	11 14	11 08	11 01	10 53	10 45	10 36	10 26	10 14	10 01	9 46	9 28	9 05	8 35
25	12 03	11 56	11 48	11 40	11 31	11 21	11 10	10 57	10 43	10 26	10 06	9 40	9 04	7 58
26	12 56	12 48	12 40	12 31	12 21	12 10	11 57	11 43	11 27	11 07	10 42	10 09	9 13	□
27	14 00	13 53	13 44	13 36	13 26	13 15	13 02	12 48	12 32	12 12	11 48	11 15	10 18	□
28	15 14	15 07	15 00	14 52	14 44	14 34	14 23	14 11	13 57	13 41	13 22	12 57	12 23	11 24
29	16 33	16 28	16 22	16 16	16 09	16 02	15 54	15 45	15 35	15 23	15 09	14 53	14 33	14 08
30	17 53	17 50	17 46	17 42	17 37	17 32	17 27	17 21	17 15	17 07	16 59	16 49	16 38	16 24
31	19 11	19 10	19 08	19 06	19 04	19 01	18 59	18 56	18 53	18 49	18 45	18 41	18 36	18 30
Feb. 1	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 27	20 28	20 28
2	21 41	21 42	21 44	21 46	21 48	21 51	21 53	21 56	21 59	22 03	22 06	22 11	22 16	22 22
3	22 52	22 56	22 59	23 03	23 07	23 12	23 17	23 23	23 29	23 36	23 44	23 53	.. ..	.. ..
4	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 04	0 16
5	0 02	0 07	0 12	0 18	0 24	0 31	0 39	0 47	0 56	1 07	1 20	1 34	1 52	2 14
6	1 10	1 16	1 23	1 30	1 38	1 47	1 57	2 08	2 20	2 35	2 52	3 14	3 42	4 23
7	2 14	2 21	2 29	2 37	2 47	2 57	3 09	3 22	3 37	3 56	4 18	4 48	5 32	■
8	3 12	3 20	3 28	3 37	3 48	3 59	4 11	4 26	4 43	5 03	5 28	6 04	7 15	■
9	4 04	4 11	4 20	4 29	4 39	4 50	5 02	5 16	5 33	5 53	6 17	6 51	7 49	■
10	4 48	4 55	5 03	5 11	5 20	5 30	5 41	5 54	6 09	6 26	6 47	7 13	7 50	9 11
11	5 26	5 32	5 38	5 45	5 53	6 02	6 11	6 22	6 34	6 47	7 04	7 23	7 48	8 21
12	5 57	6 02	6 08	6 13	6 20	6 26	6 34	6 42	6 51	7 02	7 14	7 28	7 45	8 05
13	6 25	6 29	6 33	6 37	6 42	6 47	6 52	6 58	7 05	7 12	7 20	7 30	7 41	7 55
14	6 50	6 52	6 55	6 57	7 00	7 04	7 07	7 11	7 15	7 20	7 25	7 31	7 38	7 46
15	7 12	7 14	7 15	7 16	7 17	7 19	7 21	7 22	7 24	7 26	7 29	7 32	7 35	7 38
16	7 35	7 34	7 34	7 34	7 34	7 34	7 33	7 33	7 33	7 32	7 32	7 32	7 31	7 31

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Jan. 23	0 20	0 24	0 28	0 33	0 38	0 44	0 50	0 57	1 05	1 14	1 24	1 36	1 50	2 07
24	1 25	1 31	1 37	1 43	1 51	1 58	2 07	2 17	2 27	2 40	2 55	3 12	3 34	4 03
25	2 33	2 40	2 47	2 55	3 04	3 14	3 24	3 37	3 51	4 07	4 27	4 52	5 27	6 33
26	3 40	3 48	3 56	4 05	4 15	4 26	4 38	4 52	5 09	5 28	5 53	6 26	7 22	□
27	4 44	4 52	5 00	5 09	5 19	5 30	5 42	5 57	6 13	6 33	6 58	7 31	8 27	□
28	5 40	5 47	5 55	6 03	6 12	6 22	6 33	6 45	6 59	7 16	7 36	8 01	8 36	9 35
29	6 27	6 33	6 39	6 46	6 53	7 01	7 10	7 20	7 30	7 43	7 57	8 14	8 35	9 02
30	7 07	7 11	7 16	7 21	7 26	7 31	7 37	7 44	7 52	8 00	8 09	8 20	8 33	8 48
31	7 41	7 44	7 46	7 49	7 52	7 55	7 59	8 03	8 07	8 12	8 17	8 23	8 30	8 38
Feb. 1	8 11	8 12	8 13	8 14	8 15	8 16	8 17	8 18	8 20	8 21	8 23	8 25	8 27	8 29
2	8 40	8 39	8 38	8 37	8 36	8 35	8 34	8 33	8 31	8 30	8 28	8 26	8 24	8 21
3	9 08	9 06	9 03	9 00	8 57	8 54	8 51	8 47	8 43	8 38	8 33	8 27	8 20	8 13
4	9 38	9 34	9 30	9 25	9 20	9 15	9 09	9 03	8 56	8 48	8 39	8 29	8 17	8 03
5	10 11	10 06	10 00	9 54	9 47	9 40	9 32	9 23	9 13	9 01	8 48	8 33	8 14	7 50
6	10 48	10 42	10 35	10 27	10 19	10 09	9 59	9 48	9 35	9 20	9 02	8 40	8 11	7 29
7	11 31	11 24	11 16	11 07	10 57	10 47	10 35	10 21	10 06	9 47	9 25	8 55	8 09	■
8	12 20	12 12	12 04	11 54	11 44	11 33	11 20	11 06	10 49	10 29	10 03	9 28	8 17	■
9	13 14	13 06	12 58	12 49	12 39	12 28	12 16	12 02	11 46	11 26	11 02	10 28	9 30	■
10	14 12	14 05	13 57	13 49	13 41	13 31	13 20	13 07	12 53	12 36	12 16	11 50	11 13	9 53
11	15 12	15 06	14 59	14 53	14 45	14 37	14 28	14 18	14 06	13 53	13 38	13 19	12 55	12 22
12	16 12	16 07	16 02	15 57	15 51	15 45	15 38	15 30	15 22	15 12	15 01	14 47	14 32	14 12
13	17 12	17 08	17 05	17 01	16 57	16 53	16 48	16 43	16 37	16 30	16 23	16 14	16 04	15 52
14	18 11	18 09	18 07	18 05	18 02	18 00	17 57	17 54	17 51	17 47	17 43	17 38	17 33	17 26
15	19 10	19 09	19 09	19 08	19 07	19 07	19 06	19 05	19 04	19 03	19 02	19 01	18 59	18 58
16	20 09	20 10	20 11	20 12	20 13	20 14	20 15	20 17	20 18	20 20	20 22	20 24	20 26	20 29

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

... .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	6 30	6 35	6 38	6 41	6 44	6 46	6 50	6 54	6 57	7 00	7 04	7 08	7 10	7 12
16	7 42	7 41	7 41	7 40	7 40	7 39	7 38	7 38	7 37	7 37	7 36	7 35	7 35	7 35
17	8 55	8 49	8 44	8 40	8 36	8 33	8 27	8 23	8 18	8 14	8 09	8 04	8 01	7 57
18	10 10	9 58	9 49	9 41	9 34	9 28	9 18	9 09	9 00	8 52	8 43	8 34	8 28	8 21
19	11 28	11 10	10 55	10 44	10 34	10 25	10 10	9 57	9 45	9 33	9 21	9 06	8 58	8 49
20	12 47	12 23	12 04	11 49	11 36	11 25	11 05	10 49	10 33	10 18	10 02	9 43	9 33	9 20
21	14 07	13 36	13 13	12 55	12 39	12 26	12 03	11 44	11 26	11 08	10 48	10 26	10 13	9 59
22	15 20	14 45	14 20	13 59	13 42	13 28	13 03	12 42	12 22	12 02	11 41	11 16	11 02	10 46
23	16 21	15 46	15 20	15 00	14 43	14 28	14 03	13 41	13 21	13 01	12 39	12 14	12 00	11 43
24	17 07	16 36	16 13	15 54	15 38	15 24	15 01	14 41	14 22	14 03	13 43	13 19	13 05	12 49
25	17 38	17 14	16 55	16 40	16 27	16 15	15 56	15 38	15 22	15 06	14 49	14 29	14 17	14 04
26	18 01	17 44	17 30	17 19	17 09	17 01	16 46	16 33	16 21	16 09	15 55	15 40	15 32	15 21
27	18 18	18 08	18 00	17 53	17 47	17 42	17 33	17 24	17 17	17 09	17 01	16 52	16 46	16 40
28	18 33	18 29	18 26	18 24	18 22	18 20	18 16	18 13	18 11	18 08	18 05	18 02	18 00	17 57
Mar. 1	18 46	18 49	18 51	18 53	18 54	18 56	18 58	19 01	19 03	19 05	19 07	19 10	19 12	19 13
2	19 00	19 09	19 16	19 22	19 28	19 32	19 40	19 48	19 55	20 01	20 09	20 18	20 23	20 28
3	19 16	19 31	19 43	19 53	20 02	20 10	20 23	20 35	20 47	20 58	21 10	21 24	21 32	21 42
4	19 35	19 57	20 14	20 28	20 40	20 50	21 08	21 24	21 39	21 54	22 11	22 29	22 40	22 53
5	20 01	20 28	20 50	21 07	21 22	21 34	21 56	22 15	22 33	22 51	23 10	23 32	23 46	.. ..
6	20 35	21 08	21 32	21 52	22 08	22 22	22 46	23 07	23 27	23 46	.. ..	.. ..	.. ..	0 01
7	21 22	21 56	22 22	22 42	22 59	23 14	23 38	.. ..	.. ..	.. ..	0 07	0 32	0 46	1 03
8	22 20	22 53	23 18	23 37	23 54	.. ..	.. ..	0 00	0 20	0 40	1 02	1 26	1 41	1 58
9	23 28	23 56	.. ..	.. ..	.. ..	0 08	0 32	0 52	1 12	1 31	1 52	2 15	2 29	2 46
10	.. ..	.. ..	0 18	0 36	0 50	1 03	1 25	1 43	2 01	2 18	2 37	2 59	3 11	3 25
11	0 39	1 03	1 21	1 35	1 48	1 58	2 17	2 33	2 48	3 03	3 18	3 37	3 47	3 59

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	19 27	19 25	19 24	19 23	19 22	19 21	19 19	19 18	19 16	19 15	19 13	19 12	19 11	19 10
16	19 37	19 40	19 43	19 45	19 47	19 49	19 52	19 54	19 57	19 59	20 02	20 05	20 07	20 09
17	19 47	19 55	20 02	20 08	20 13	20 17	20 25	20 32	20 38	20 45	20 51	20 59	21 04	21 09
18	19 59	20 13	20 24	20 33	20 41	20 48	21 01	21 12	21 22	21 32	21 43	21 55	22 02	22 11
19	20 14	20 34	20 50	21 02	21 13	21 23	21 40	21 54	22 08	22 22	22 36	22 53	23 03	23 15
20	20 35	21 01	21 21	21 37	21 51	22 03	22 23	22 41	22 58	23 15	23 33	23 54	.. ..	.. ..
21	21 05	21 36	22 00	22 19	22 35	22 49	23 13	23 33	23 52	.. ..	.. ..	.. ..	0 06	0 20
22	21 49	22 24	22 50	23 11	23 28	23 43	.. ..	.. ..	.. ..	0 11	0 32	0 55	1 09	1 26
23	22 53	23 27	23 53	.. ..	.. ..	.. ..	0 08	0 30	0 50	1 10	1 32	1 57	2 11	2 28
24	.. ..	.. ..	.. ..	0 13	0 30	0 44	1 09	1 30	1 50	2 10	2 31	2 55	3 09	3 26
25	0 13	0 43	1 06	1 24	1 39	1 52	2 14	2 33	2 51	3 09	3 27	3 49	4 01	4 16
26	1 46	2 08	2 26	2 40	2 52	3 03	3 21	3 36	3 50	4 05	4 20	4 37	4 47	4 58
27	3 22	3 37	3 49	3 59	4 07	4 14	4 27	4 38	4 48	4 58	5 08	5 20	5 27	5 35
28	4 58	5 06	5 12	5 17	5 21	5 25	5 32	5 37	5 42	5 48	5 53	5 59	6 03	6 07
Mar. 1	6 32	6 33	6 33	6 34	6 34	6 34	6 35	6 35	6 35	6 36	6 36	6 36	6 36	6 37
2	8 05	7 59	7 53	7 49	7 46	7 42	7 37	7 32	7 27	7 23	7 18	7 12	7 09	7 06
3	9 36	9 23	9 12	9 03	8 56	8 49	8 38	8 28	8 19	8 10	8 00	7 49	7 43	7 36
4	11 05	10 45	10 29	10 16	10 05	9 55	9 39	9 25	9 12	8 58	8 44	8 28	8 19	8 08
5	12 29	12 03	11 42	11 26	11 12	11 00	10 39	10 21	10 05	9 48	9 31	9 10	8 59	8 45
6	13 46	13 14	12 50	12 31	12 15	12 01	11 38	11 18	10 59	10 40	10 20	9 56	9 43	9 27
7	14 50	14 16	13 50	13 30	13 13	12 59	12 34	12 12	11 52	11 32	11 11	10 46	10 32	10 15
8	15 39	15 06	14 41	14 22	14 05	13 51	13 26	13 05	12 45	12 25	12 04	11 39	11 25	11 08
9	16 15	15 46	15 23	15 05	14 50	14 37	14 14	13 54	13 36	13 17	12 57	12 34	12 21	12 05
10	16 41	16 16	15 57	15 42	15 29	15 17	14 57	14 40	14 24	14 08	13 50	13 30	13 18	13 04
11	17 00	16 41	16 26	16 13	16 02	15 53	15 37	15 23	15 09	14 56	14 42	14 25	14 15	14 04

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	7 12	7 14	7 15	7 16	7 17	7 19	7 21	7 22	7 24	7 26	7 29	7 32	7 35	7 38
16	7 35	7 34	7 34	7 34	7 34	7 34	7 33	7 33	7 33	7 32	7 32	7 32	7 31	7 31
17	7 57	7 56	7 54	7 52	7 51	7 49	7 47	7 44	7 42	7 39	7 36	7 32	7 28	7 23
18	8 21	8 19	8 16	8 12	8 09	8 05	8 01	7 57	7 52	7 46	7 40	7 33	7 25	7 15
19	8 49	8 44	8 40	8 35	8 30	8 24	8 18	8 11	8 04	7 56	7 46	7 35	7 22	7 07
20	9 20	9 15	9 09	9 03	8 56	8 48	8 40	8 31	8 20	8 09	7 55	7 39	7 20	6 55
21	9 59	9 52	9 45	9 37	9 29	9 19	9 09	8 57	8 44	8 29	8 11	7 48	7 19	6 36
22	10 46	10 38	10 30	10 21	10 12	10 01	9 49	9 36	9 20	9 01	8 39	8 09	7 23	□
23	11 43	11 35	11 27	11 17	11 08	10 56	10 44	10 30	10 13	9 53	9 28	8 55	7 55	□
24	12 49	12 42	12 34	12 26	12 17	12 06	11 55	11 42	11 27	11 09	10 47	10 18	9 35	□
25	14 04	13 58	13 51	13 44	13 36	13 28	13 18	13 08	12 56	12 42	12 25	12 05	11 39	11 03
26	15 21	15 17	15 12	15 07	15 01	14 55	14 48	14 41	14 32	14 23	14 12	13 59	13 43	13 24
27	16 40	16 37	16 34	16 31	16 28	16 24	16 20	16 15	16 10	16 05	15 59	15 51	15 43	15 33
28	17 57	17 56	17 55	17 54	17 53	17 52	17 50	17 49	17 47	17 45	17 43	17 41	17 38	17 35
Mar. 1	19 13	19 14	19 15	19 16	19 17	19 18	19 19	19 21	19 22	19 24	19 26	19 28	19 30	19 33
2	20 28	20 31	20 33	20 36	20 40	20 43	20 47	20 51	20 55	21 01	21 06	21 13	21 21	21 30
3	21 42	21 46	21 50	21 55	22 00	22 06	22 12	22 19	22 27	22 36	22 46	22 58	23 12	23 29
4	22 53	22 59	23 05	23 11	23 18	23 26	23 35	23 45	23 56	...	...	...	...	...
5	...	...	...	...	...	...	...	...	...	0 09	0 24	0 42	1 05	1 35
6	0 01	0 08	0 15	0 23	0 32	0 41	0 52	1 05	1 19	1 36	1 56	2 21	2 57	4 10
7	1 03	1 11	1 19	1 28	1 37	1 48	2 01	2 14	2 31	2 50	3 15	3 47	4 44	■
8	1 58	2 06	2 14	2 23	2 33	2 44	2 57	3 11	3 28	3 47	4 12	4 46	5 48	■
9	2 46	2 53	3 01	3 09	3 18	3 29	3 40	3 54	4 09	4 27	4 49	5 17	5 58	■
10	3 25	3 32	3 39	3 46	3 54	4 03	4 13	4 25	4 37	4 52	5 10	5 31	5 58	6 38
11	3 59	4 04	4 10	4 16	4 23	4 30	4 39	4 47	4 58	5 09	5 22	5 38	5 57	6 20

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Feb. 15	19 10	19 09	19 09	19 08	19 07	19 07	19 06	19 05	19 04	19 03	19 02	19 01	18 59	18 58
16	20 09	20 10	20 11	20 12	20 13	20 14	20 15	20 17	20 18	20 20	20 22	20 24	20 26	20 29
17	21 09	21 11	21 14	21 16	21 19	21 22	21 26	21 29	21 33	21 38	21 43	21 49	21 56	22 04
18	22 11	22 14	22 18	22 23	22 27	22 32	22 38	22 44	22 51	22 58	23 07	23 17	23 29	23 43
19	23 15	23 20	23 25	23 31	23 37	23 44	23 52	...	...	...	...	...	...	...
20	...	...	...	...	...	...	...	0 01	0 11	0 22	0 34	0 50	1 08	1 32
21	0 20	0 26	0 33	0 41	0 49	0 58	1 08	1 19	1 32	1 46	2 04	2 26	2 55	3 37
22	1 26	1 33	1 41	1 49	1 59	2 09	2 21	2 34	2 50	3 08	3 31	4 00	4 45	□
23	2 28	2 36	2 45	2 54	3 04	3 15	3 27	3 41	3 58	4 18	4 43	5 16	6 16	□
24	3 26	3 33	3 41	3 50	3 59	4 10	4 22	4 35	4 51	5 09	5 31	6 00	6 43	□
25	4 16	4 22	4 29	4 37	4 45	4 54	5 04	5 15	5 27	5 42	5 59	6 20	6 46	7 23
26	4 58	5 03	5 09	5 14	5 21	5 28	5 35	5 43	5 53	6 03	6 15	6 29	6 45	7 06
27	5 35	5 38	5 42	5 46	5 50	5 54	5 59	6 05	6 11	6 17	6 25	6 33	6 43	6 55
28	6 07	6 08	6 10	6 12	6 14	6 17	6 19	6 22	6 25	6 28	6 32	6 36	6 41	6 46
Mar. 1	6 37	6 37	6 37	6 37	6 37	6 37	6 37	6 37	6 37	6 37	6 37	6 38	6 38	6 38
2	7 06	7 04	7 02	7 01	6 59	6 57	6 54	6 52	6 49	6 46	6 43	6 39	6 35	6 30
3	7 36	7 33	7 29	7 26	7 22	7 17	7 13	7 08	7 02	6 56	6 49	6 41	6 32	6 21
4	8 08	8 04	7 59	7 53	7 47	7 41	7 34	7 26	7 18	7 08	6 57	6 44	6 29	6 11
5	8 45	8 39	8 33	8 26	8 18	8 10	8 00	7 50	7 38	7 25	7 09	6 50	6 27	5 56
6	9 27	9 20	9 12	9 04	8 55	8 45	8 34	8 21	8 07	7 50	7 29	7 03	6 27	5 13
7	10 15	10 07	9 59	9 50	9 40	9 29	9 17	9 03	8 46	8 27	8 02	7 29	6 33	■
8	11 08	11 00	10 52	10 43	10 33	10 22	10 10	9 55	9 39	9 19	8 54	8 20	7 19	■
9	12 05	11 58	11 50	11 42	11 33	11 23	11 11	10 58	10 43	10 26	10 04	9 36	8 55	■
10	13 04	12 58	12 51	12 44	12 36	12 28	12 18	12 07	11 55	11 41	11 24	11 03	10 36	9 57
11	14 04	13 59	13 54	13 48	13 42	13 35	13 27	13 19	13 09	12 59	12 46	12 31	12 13	11 50

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

... indicates phenomenon will occur the next day.

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MOONRISE AND MOONSET, 2010

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	23 28	23 56	.. ..	.. ..	.. ..	0 08	0 32	0 52	1 12	1 31	1 52	2 15	2 29	2 46
10	.. ..	.. ..	0 18	0 36	0 50	1 03	1 25	1 43	2 01	2 18	2 37	2 59	3 11	3 25
11	0 39	1 03	1 21	1 35	1 48	1 58	2 17	2 33	2 48	3 03	3 18	3 37	3 47	3 59
12	1 53	2 10	2 24	2 35	2 45	2 53	3 08	3 20	3 32	3 44	3 56	4 11	4 19	4 28
13	3 06	3 17	3 27	3 35	3 41	3 47	3 57	4 06	4 15	4 23	4 32	4 42	4 47	4 54
14	4 18	4 24	4 30	4 34	4 38	4 41	4 46	4 51	4 56	5 00	5 05	5 11	5 14	5 17
15	5 31	5 32	5 32	5 33	5 34	5 34	5 35	5 36	5 36	5 37	5 38	5 39	5 39	5 40
16	6 44	6 39	6 36	6 33	6 30	6 28	6 24	6 21	6 17	6 14	6 11	6 07	6 05	6 03
17	7 59	7 48	7 40	7 34	7 28	7 23	7 14	7 07	7 00	6 53	6 45	6 37	6 32	6 27
18	9 16	9 00	8 47	8 36	8 28	8 20	8 06	7 55	7 44	7 33	7 22	7 09	7 02	6 53
19	10 35	10 12	9 55	9 41	9 29	9 19	9 01	8 46	8 31	8 17	8 02	7 45	7 35	7 24
20	11 54	11 25	11 04	10 46	10 32	10 19	9 58	9 39	9 22	9 05	8 47	8 26	8 14	8 00
21	13 08	12 35	12 10	11 51	11 34	11 20	10 56	10 36	10 16	9 57	9 37	9 13	8 59	8 43
22	14 12	13 38	13 12	12 52	12 35	12 20	11 55	11 33	11 13	10 53	10 32	10 07	9 53	9 36
23	15 02	14 30	14 05	13 46	13 30	13 16	12 52	12 31	12 12	11 53	11 32	11 08	10 54	10 38
24	15 37	15 11	14 50	14 33	14 19	14 07	13 46	13 28	13 11	12 53	12 35	12 13	12 01	11 47
25	16 03	15 43	15 27	15 14	15 03	14 53	14 36	14 21	14 08	13 54	13 39	13 22	13 12	13 00
26	16 22	16 08	15 58	15 49	15 41	15 34	15 23	15 12	15 03	14 53	14 42	14 30	14 23	14 15
27	16 37	16 30	16 25	16 20	16 16	16 13	16 06	16 01	15 56	15 50	15 45	15 39	15 35	15 31
28	16 51	16 50	16 50	16 49	16 49	16 49	16 48	16 48	16 48	16 47	16 47	16 46	16 46	16 46
29	17 05	17 10	17 15	17 19	17 22	17 25	17 30	17 35	17 39	17 44	17 48	17 54	17 57	18 01
30	17 20	17 31	17 41	17 49	17 56	18 02	18 13	18 22	18 31	18 40	18 50	19 01	19 08	19 15
31	17 38	17 56	18 10	18 22	18 33	18 42	18 58	19 11	19 25	19 38	19 52	20 08	20 18	20 29
Apr. 1	18 01	18 25	18 45	19 00	19 14	19 25	19 45	20 03	20 19	20 36	20 53	21 14	21 26	21 40
2	18 32	19 02	19 25	19 44	19 59	20 13	20 36	20 56	21 14	21 33	21 53	22 17	22 31	22 47

MOONSET														
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	16 15	15 46	15 23	15 05	14 50	14 37	14 14	13 54	13 36	13 17	12 57	12 34	12 21	12 05
10	16 41	16 16	15 57	15 42	15 29	15 17	14 57	14 40	14 24	14 08	13 50	13 30	13 18	13 04
11	17 00	16 41	16 26	16 13	16 02	15 53	15 37	15 23	15 09	14 56	14 42	14 25	14 15	14 04
12	17 14	17 00	16 49	16 40	16 32	16 26	16 13	16 03	15 53	15 43	15 32	15 20	15 12	15 04
13	17 26	17 17	17 11	17 05	17 00	16 55	16 48	16 41	16 35	16 28	16 21	16 13	16 09	16 03
14	17 36	17 33	17 30	17 28	17 26	17 24	17 21	17 18	17 15	17 13	17 10	17 06	17 05	17 02
15	17 46	17 48	17 49	17 50	17 51	17 52	17 54	17 55	17 56	17 57	17 58	18 00	18 01	18 02
16	17 57	18 03	18 09	18 13	18 17	18 21	18 27	18 32	18 37	18 43	18 48	18 54	18 58	19 02
17	18 09	18 21	18 30	18 38	18 45	18 52	19 02	19 12	19 21	19 30	19 39	19 50	19 56	20 04
18	18 23	18 41	18 55	19 07	19 17	19 25	19 40	19 54	20 06	20 19	20 32	20 48	20 57	21 07
19	18 42	19 06	19 24	19 39	19 52	20 03	20 23	20 39	20 55	21 11	21 28	21 48	21 59	22 12
20	19 09	19 39	20 01	20 19	20 34	20 47	21 10	21 29	21 48	22 06	22 26	22 48	23 02	23 17
21	19 48	20 22	20 47	21 07	21 24	21 38	22 02	22 24	22 43	23 03	23 24	23 49	.. ..	.. ..
22	20 44	21 18	21 44	22 04	22 21	22 35	23 00	23 22	23 41	.. ..	.. ..	.. ..	0 03	0 20
23	21 56	22 27	22 51	23 09	23 25	23 39	.. ..	.. ..	.. ..	0 01	0 22	0 47	1 01	1 18
24	23 20	23 46	.. ..	.. ..	.. ..	.. ..	0 02	0 22	0 40	0 58	1 18	1 41	1 54	2 09
25	.. ..	.. ..	0 05	0 21	0 34	0 46	1 05	1 22	1 38	1 54	2 10	2 29	2 40	2 53
26	0 52	1 10	1 24	1 36	1 46	1 54	2 09	2 22	2 34	2 46	2 58	3 13	3 21	3 30
27	2 24	2 35	2 44	2 51	2 57	3 03	3 12	3 20	3 28	3 35	3 43	3 52	3 57	4 03
28	3 57	4 01	4 04	4 07	4 09	4 11	4 14	4 17	4 20	4 23	4 26	4 29	4 31	4 33
29	5 28	5 26	5 23	5 22	5 20	5 19	5 16	5 14	5 12	5 10	5 08	5 05	5 04	5 02
30	7 00	6 50	6 42	6 36	6 31	6 26	6 18	6 10	6 04	5 57	5 50	5 42	5 37	5 32
31	8 30	8 14	8 01	7 50	7 41	7 33	7 19	7 08	6 56	6 45	6 33	6 20	6 12	6 04
Apr. 1	9 59	9 36	9 18	9 03	8 51	8 40	8 21	8 05	7 50	7 36	7 20	7 02	6 51	6 39
2	11 22	10 52	10 30	10 12	9 57	9 44	9 22	9 03	8 46	8 28	8 09	7 47	7 34	7 20

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	2 46	2 53	3 01	3 09	3 18	3 29	3 40	3 54	4 09	4 27	4 49	5 17	5 58	■
10	3 25	3 32	3 39	3 46	3 54	4 03	4 13	4 25	4 37	4 52	5 10	5 31	5 58	6 38
11	3 59	4 04	4 10	4 16	4 23	4 30	4 39	4 47	4 58	5 09	5 22	5 38	5 57	6 20
12	4 28	4 32	4 37	4 41	4 47	4 52	4 58	5 05	5 12	5 21	5 30	5 41	5 54	6 09
13	4 54	4 57	5 00	5 03	5 06	5 10	5 14	5 19	5 24	5 30	5 36	5 43	5 51	6 01
14	5 17	5 19	5 21	5 22	5 24	5 26	5 29	5 31	5 34	5 37	5 40	5 44	5 48	5 53
15	5 40	5 40	5 41	5 41	5 41	5 41	5 42	5 42	5 43	5 43	5 44	5 44	5 45	5 46
16	6 03	6 02	6 01	5 59	5 58	5 57	5 55	5 54	5 52	5 50	5 48	5 45	5 42	5 39
17	6 27	6 24	6 22	6 19	6 16	6 13	6 10	6 06	6 02	5 57	5 52	5 46	5 40	5 32
18	6 53	6 49	6 45	6 41	6 37	6 32	6 26	6 20	6 14	6 06	5 58	5 48	5 37	5 24
19	7 24	7 19	7 13	7 07	7 01	6 54	6 47	6 38	6 29	6 19	6 06	5 52	5 35	5 15
20	8 00	7 54	7 47	7 40	7 32	7 23	7 13	7 03	6 51	6 37	6 20	6 00	5 35	5 01
21	8 43	8 36	8 29	8 20	8 11	8 01	7 50	7 37	7 22	7 05	6 44	6 17	5 39	4 08
22	9 36	9 28	9 20	9 11	9 01	8 51	8 38	8 24	8 08	7 49	7 25	6 53	6 00	□
23	10 38	10 30	10 22	10 14	10 04	9 54	9 42	9 28	9 13	8 54	8 31	8 01	7 14	□
24	11 47	11 40	11 33	11 25	11 17	11 08	10 58	10 46	10 33	10 18	9 59	9 37	9 06	8 19
25	13 00	12 55	12 49	12 43	12 37	12 30	12 22	12 13	12 03	11 52	11 39	11 23	11 04	10 40
26	14 15	14 12	14 08	14 04	14 00	13 55	13 49	13 44	13 37	13 30	13 21	13 12	13 01	12 47
27	15 31	15 29	15 27	15 25	15 23	15 20	15 18	15 15	15 11	15 08	15 04	14 59	14 53	14 47
28	16 46	16 46	16 46	16 46	16 45	16 45	16 45	16 45	16 45	16 45	16 44	16 44	16 44	16 44
29	18 01	18 02	18 04	18 06	18 08	18 10	18 12	18 15	18 18	18 21	18 25	18 29	18 34	18 39
30	19 15	19 18	19 22	19 26	19 30	19 34	19 39	19 45	19 51	19 58	20 05	20 14	20 25	20 37
31	20 29	20 34	20 39	20 44	20 51	20 57	21 05	21 13	21 23	21 33	21 46	22 00	22 18	22 40
Apr. 1	21 40	21 46	21 53	22 00	22 08	22 17	22 27	22 38	22 51	23 05	23 23	23 44	...	...
2	22 47	22 54	23 02	23 10	23 20	23 30	23 41	23 55	...	...	...	...	0 12	0 53

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Mar. 9	12 05	11 58	11 50	11 42	11 33	11 23	11 11	10 58	10 43	10 26	10 04	9 36	8 55	■
10	13 04	12 58	12 51	12 44	12 36	12 28	12 18	12 07	11 55	11 41	11 24	11 03	10 36	9 57
11	14 04	13 59	13 54	13 48	13 42	13 35	13 27	13 19	13 09	12 59	12 46	12 31	12 13	11 50
12	15 04	15 00	14 56	14 52	14 48	14 43	14 37	14 31	14 24	14 17	14 08	13 58	13 46	13 32
13	16 03	16 01	15 59	15 56	15 53	15 50	15 46	15 43	15 38	15 34	15 28	15 22	15 15	15 07
14	17 02	17 01	17 00	16 59	16 58	16 57	16 55	16 54	16 52	16 50	16 48	16 46	16 43	16 40
15	18 02	18 02	18 03	18 03	18 03	18 04	18 05	18 05	18 06	18 07	18 08	18 09	18 10	18 11
16	19 02	19 04	19 06	19 08	19 10	19 12	19 15	19 18	19 21	19 25	19 29	19 33	19 39	19 45
17	20 04	20 07	20 10	20 14	20 18	20 22	20 27	20 32	20 38	20 45	20 52	21 01	21 11	21 23
18	21 07	21 12	21 17	21 22	21 28	21 34	21 41	21 49	21 58	22 07	22 19	22 32	22 48	23 08
19	22 12	22 18	22 24	22 31	22 39	22 47	22 56	23 06	23 18	23 32	23 47	...	...	...
20	23 17	23 24	23 32	23 40	23 49	23 59	...	...	...	...	...	0 07	0 31	1 05
21	...	...	...	...	...	...	0 10	0 22	0 37	0 54	1 14	1 41	2 18	3 49
22	0 20	0 28	0 36	0 45	0 54	1 05	1 17	1 31	1 47	2 07	2 30	3 02	3 55	□
23	1 18	1 25	1 33	1 42	1 52	2 03	2 15	2 28	2 44	3 03	3 26	3 56	4 43	□
24	2 09	2 16	2 23	2 31	2 39	2 49	3 00	3 11	3 25	3 41	4 00	4 23	4 54	5 42
25	2 53	2 58	3 04	3 11	3 18	3 25	3 34	3 43	3 54	4 06	4 19	4 36	4 56	5 21
26	3 30	3 34	3 39	3 43	3 48	3 54	4 00	4 07	4 14	4 22	4 32	4 42	4 55	5 10
27	4 03	4 06	4 08	4 11	4 14	4 18	4 21	4 25	4 29	4 34	4 40	4 46	4 53	5 01
28	4 33	4 34	4 35	4 36	4 37	4 38	4 40	4 41	4 43	4 44	4 46	4 48	4 51	4 53
29	5 02	5 01	5 01	5 00	4 59	4 58	4 57	4 56	4 55	4 53	4 52	4 50	4 48	4 46
30	5 32	5 29	5 27	5 24	5 21	5 18	5 15	5 11	5 07	5 03	4 58	4 52	4 46	4 38
31	6 04	6 00	5 55	5 51	5 46	5 41	5 35	5 29	5 22	5 14	5 06	4 55	4 44	4 30
Apr. 1	6 39	6 34	6 28	6 22	6 15	6 08	6 00	5 51	5 41	5 29	5 16	5 01	4 42	4 19
2	7 20	7 13	7 06	6 58	6 50	6 41	6 31	6 19	6 06	5 51	5 33	5 11	4 42	4 01

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

... .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	18 01	18 25	18 45	19 00	19 14	19 25	19 45	20 03	20 19	20 36	20 53	21 14	21 26	21 40
2	18 32	19 02	19 25	19 44	19 59	20 13	20 36	20 56	21 14	21 33	21 53	22 17	22 31	22 47
3	19 15	19 48	20 13	20 33	20 50	21 04	21 29	21 50	22 10	22 29	22 51	23 15	23 30	23 47
4	20 10	20 43	21 08	21 28	21 44	21 58	22 23	22 44	23 03	23 23	23 44	...	...	...
5	21 15	21 45	22 08	22 26	22 41	22 54	23 17	23 36	23 54	...	...	0 08	0 22	0 38
6	22 26	22 51	23 10	23 26	23 39	23 51	...	...	...	0 12	0 32	0 54	1 07	1 22
7	23 39	23 59	...	...	...	...	0 10	0 27	0 43	0 58	1 15	1 34	1 46	1 58
8	...	...	0 14	0 26	0 37	0 46	1 02	1 15	1 28	1 41	1 55	2 10	2 19	2 29
9	0 52	1 06	1 17	1 26	1 33	1 40	1 52	2 02	2 11	2 21	2 31	2 42	2 49	2 56
10	2 04	2 13	2 19	2 25	2 29	2 34	2 41	2 47	2 53	2 59	3 05	3 12	3 16	3 20
11	3 17	3 19	3 22	3 24	3 25	3 27	3 29	3 31	3 34	3 36	3 38	3 40	3 42	3 44
12	4 29	4 27	4 25	4 23	4 22	4 20	4 18	4 16	4 15	4 13	4 11	4 09	4 08	4 06
13	5 44	5 36	5 29	5 24	5 19	5 15	5 08	5 02	4 57	4 51	4 45	4 38	4 35	4 30
14	7 01	6 47	6 36	6 27	6 19	6 12	6 00	5 50	5 41	5 31	5 21	5 10	5 04	4 56
15	8 20	8 00	7 44	7 31	7 20	7 11	6 55	6 41	6 28	6 15	6 01	5 45	5 36	5 26
16	9 40	9 14	8 54	8 37	8 24	8 12	7 52	7 34	7 18	7 02	6 45	6 25	6 14	6 01
17	10 57	10 26	10 02	9 43	9 27	9 14	8 51	8 31	8 12	7 54	7 34	7 11	6 58	6 43
18	12 05	11 31	11 06	10 46	10 29	10 14	9 50	9 29	9 09	8 49	8 28	8 04	7 50	7 33
19	12 59	12 26	12 02	11 42	11 26	11 12	10 47	10 27	10 07	9 48	9 27	9 03	8 49	8 32
20	13 38	13 10	12 48	12 31	12 16	12 04	11 42	11 23	11 05	10 47	10 28	10 06	9 53	9 38
21	14 06	13 44	13 27	13 13	13 01	12 50	12 32	12 16	12 02	11 47	11 31	11 12	11 02	10 49
22	14 26	14 11	13 59	13 48	13 40	13 32	13 19	13 07	12 56	12 45	12 33	12 19	12 11	12 02
23	14 42	14 33	14 26	14 20	14 15	14 10	14 02	13 54	13 48	13 41	13 34	13 25	13 20	13 15
24	14 56	14 53	14 51	14 49	14 47	14 46	14 43	14 40	14 38	14 36	14 34	14 31	14 29	14 28
25	15 10	15 13	15 15	15 17	15 19	15 21	15 23	15 26	15 28	15 31	15 33	15 36	15 38	15 40

MOONSET

Apr.	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	9 59	9 36	9 18	9 03	8 51	8 40	8 21	8 05	7 50	7 36	7 20	7 02	6 51	6 39
2	11 22	10 52	10 30	10 12	9 57	9 44	9 22	9 03	8 46	8 28	8 09	7 47	7 34	7 20
3	12 33	12 00	11 36	11 16	11 00	10 45	10 21	10 00	9 41	9 22	9 01	8 37	8 22	8 06
4	13 30	12 57	12 32	12 12	11 56	11 41	11 17	10 55	10 36	10 16	9 54	9 30	9 15	8 58
5	14 12	13 42	13 19	13 00	12 44	12 31	12 07	11 47	11 28	11 09	10 49	10 25	10 11	9 55
6	14 42	14 16	13 56	13 40	13 26	13 14	12 53	12 35	12 18	12 01	11 43	11 21	11 09	10 55
7	15 04	14 43	14 27	14 13	14 02	13 52	13 34	13 19	13 05	12 51	12 35	12 17	12 07	11 55
8	15 20	15 05	14 52	14 42	14 33	14 26	14 12	14 00	13 49	13 38	13 26	13 12	13 04	12 55
9	15 33	15 23	15 14	15 08	15 02	14 56	14 47	14 39	14 31	14 24	14 16	14 06	14 01	13 54
10	15 44	15 39	15 35	15 31	15 28	15 25	15 21	15 16	15 12	15 08	15 04	14 59	14 56	14 53
11	15 54	15 54	15 54	15 54	15 54	15 54	15 54	15 53	15 53	15 53	15 53	15 53	15 52	15 52
12	16 05	16 10	16 14	16 17	16 20	16 22	16 27	16 31	16 35	16 38	16 42	16 47	16 49	16 52
13	16 17	16 27	16 35	16 42	16 48	16 53	17 02	17 10	17 17	17 25	17 33	17 42	17 48	17 54
14	16 31	16 46	16 59	17 09	17 18	17 26	17 40	17 52	18 03	18 14	18 26	18 40	18 48	18 57
15	16 49	17 10	17 27	17 41	17 53	18 03	18 21	18 37	18 51	19 06	19 22	19 40	19 51	20 03
16	17 14	17 41	18 02	18 19	18 33	18 46	19 07	19 26	19 44	20 01	20 20	20 41	20 54	21 09
17	17 50	18 22	18 46	19 05	19 21	19 35	19 59	20 20	20 39	20 58	21 19	21 43	21 57	22 13
18	18 40	19 14	19 40	20 00	20 17	20 31	20 56	21 17	21 37	21 56	22 18	22 42	22 56	23 13
19	19 47	20 20	20 44	21 03	21 19	21 33	21 56	22 16	22 35	22 54	23 14	23 37	23 50	...
20	21 08	21 35	21 55	22 12	22 26	22 38	22 58	23 16	23 32	23 49	...	...	...	0 06
21	22 35	22 55	23 11	23 24	23 35	23 44	...	...	...	...	0 06	0 26	0 38	0 51
22	...	...	...	...	...	...	0 00	0 15	0 28	0 41	0 54	1 10	1 19	1 29
23	0 04	0 18	0 28	0 37	0 44	0 51	1 02	1 12	1 21	1 30	1 39	1 50	1 56	2 03
24	1 33	1 40	1 45	1 50	1 53	1 57	2 02	2 07	2 12	2 16	2 21	2 26	2 29	2 33
25	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 01	3 01

... .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	21 40	21 46	21 53	22 00	22 08	22 17	22 27	22 38	22 51	23 05	23 23	23 44	...	...
2	22 47	22 54	23 02	23 10	23 20	23 30	23 41	23 55	...	...	...	...	...	...
3	23 47	23 54	...	...	...	...	...	...	0 10	0 28	0 50	1 19	2 03	■
4	...	...	0 02	0 11	0 21	0 32	0 45	0 59	1 15	1 35	1 59	2 32	3 29	■
5	0 38	0 46	0 54	1 02	1 12	1 23	1 34	1 48	2 04	2 22	2 45	3 15	4 00	■
6	1 22	1 29	1 36	1 44	1 52	2 02	2 12	2 24	2 37	2 53	3 12	3 35	4 06	4 54
7	1 58	2 04	2 10	2 17	2 24	2 32	2 40	2 50	3 01	3 13	3 28	3 45	4 06	4 33
8	2 29	2 34	2 39	2 44	2 49	2 56	3 02	3 10	3 18	3 27	3 38	3 50	4 05	4 22
9	2 56	2 59	3 03	3 07	3 11	3 15	3 20	3 25	3 31	3 37	3 45	3 53	4 03	4 14
10	3 20	3 22	3 25	3 27	3 29	3 32	3 35	3 38	3 42	3 45	3 50	3 55	4 00	4 07
11	3 44	3 44	3 45	3 46	3 47	3 48	3 49	3 50	3 51	3 52	3 54	3 56	3 58	4 00
12	4 06	4 06	4 05	4 05	4 04	4 03	4 02	4 01	4 00	3 59	3 58	3 57	3 55	3 53
13	4 30	4 28	4 26	4 24	4 22	4 19	4 17	4 14	4 10	4 07	4 03	3 58	3 53	3 47
14	4 56	4 53	4 49	4 46	4 42	4 37	4 33	4 28	4 22	4 16	4 08	4 00	3 51	3 40
15	5 26	5 21	5 16	5 11	5 05	4 59	4 52	4 45	4 37	4 27	4 17	4 04	3 50	3 32
16	6 01	5 55	5 49	5 42	5 35	5 27	5 18	5 08	4 57	4 44	4 29	4 12	3 50	3 22
17	6 43	6 36	6 28	6 20	6 12	6 02	5 51	5 39	5 25	5 09	4 50	4 26	3 54	3 02
18	7 33	7 26	7 18	7 09	6 59	6 49	6 37	6 23	6 08	5 49	5 26	4 56	4 11	□
19	8 32	8 25	8 17	8 08	7 58	7 48	7 36	7 22	7 07	6 48	6 25	5 55	5 08	□
20	9 38	9 32	9 25	9 17	9 08	8 59	8 48	8 36	8 22	8 06	7 47	7 22	6 49	5 52
21	10 49	10 44	10 38	10 31	10 25	10 17	10 08	9 59	9 48	9 36	9 21	9 04	8 43	8 15
22	12 02	11 58	11 54	11 49	11 44	11 39	11 32	11 26	11 18	11 10	11 00	10 49	10 36	10 19
23	13 15	13 13	13 10	13 07	13 04	13 01	12 57	12 53	12 49	12 44	12 39	12 32	12 25	12 16
24	14 28	14 27	14 26	14 25	14 24	14 23	14 22	14 21	14 19	14 18	14 16	14 14	14 12	14 09
25	15 40	15 41	15 42	15 43	15 44	15 45	15 46	15 48	15 49	15 51	15 53	15 55	15 58	16 01

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 1	6 39	6 34	6 28	6 22	6 15	6 08	6 00	5 51	5 41	5 29	5 16	5 01	4 42	4 19
2	7 20	7 13	7 06	6 58	6 50	6 41	6 31	6 19	6 06	5 51	5 33	5 11	4 42	4 01
3	8 06	7 59	7 51	7 42	7 33	7 22	7 10	6 57	6 42	6 23	6 01	5 32	4 48	■
4	8 58	8 51	8 43	8 34	8 24	8 13	8 01	7 46	7 30	7 11	6 46	6 13	5 16	■
5	9 55	9 48	9 40	9 32	9 22	9 12	9 00	8 47	8 31	8 13	7 51	7 21	6 36	■
6	10 55	10 48	10 41	10 34	10 25	10 16	10 06	9 55	9 42	9 26	9 08	8 45	8 15	7 28
7	11 55	11 50	11 44	11 38	11 31	11 23	11 15	11 06	10 56	10 44	10 30	10 13	9 53	9 27
8	12 55	12 51	12 46	12 42	12 37	12 31	12 25	12 18	12 10	12 02	11 52	11 40	11 27	11 10
9	13 54	13 51	13 49	13 45	13 42	13 38	13 34	13 29	13 24	13 19	13 12	13 05	12 57	12 47
10	14 53	14 52	14 50	14 49	14 47	14 45	14 43	14 40	14 38	14 35	14 32	14 28	14 24	14 19
11	15 52	15 52	15 52	15 52	15 52	15 52	15 52	15 52	15 51	15 51	15 51	15 51	15 51	15 50
12	16 52	16 54	16 55	16 56	16 58	17 00	17 02	17 04	17 06	17 09	17 11	17 15	17 18	17 23
13	17 54	17 56	17 59	18 02	18 06	18 09	18 13	18 18	18 23	18 28	18 34	18 41	18 50	18 59
14	18 57	19 02	19 06	19 11	19 16	19 21	19 28	19 34	19 42	19 51	20 01	20 12	20 26	20 42
15	20 03	20 08	20 14	20 20	20 27	20 35	20 43	20 53	21 03	21 15	21 30	21 47	22 07	22 35
16	21 09	21 15	21 23	21 30	21 39	21 48	21 58	22 10	22 24	22 39	22 58	23 22	23 54	...
17	22 13	22 21	22 28	22 37	22 47	22 57	23 09	23 22	23 38	23 56	...	...	...	0 45
18	23 13	23 20	23 28	23 37	23 47	23 58	...	...	...	...	0 19	0 49	1 34	□
19	...	...	...	...	...	...	0 10	0 23	0 39	0 58	1 21	1 51	2 39	□
20	0 06	0 13	0 20	0 28	0 37	0 47	0 58	1 10	1 24	1 41	2 01	2 25	2 59	3 56
21	0 51	0 57	1 03	1 10	1 18	1 26	1 35	1 45	1 56	2 09	2 24	2 42	3 04	3 33
22	1 29	1 34	1 39	1 44	1 50	1 56	2 03	2 10	2 18	2 28	2 38	2 50	3 05	3 22
23	2 03	2 06	2 09	2 13	2 16	2 20	2 25	2 30	2 35	2 41	2 48	2 55	3 04	3 14
24	2 33	2 34	2 36	2 38	2 40	2 42	2 44	2 46	2 49	2 51	2 55	2 58	3 02	3 07
25	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 00	3 00	3 00

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

... .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45	-40°	-35°	-30°	-20	-10	0°	+10°	+20°	+30°	+35	+40
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	14 56	14 53	14 51	14 49	14 47	14 46	14 43	14 40	14 38	14 36	14 34	14 31	14 29	14 28
25	15 10	15 13	15 15	15 17	15 19	15 21	15 23	15 26	15 28	15 31	15 33	15 36	15 38	15 40
26	15 24	15 33	15 40	15 46	15 52	15 56	16 05	16 12	16 19	16 26	16 33	16 42	16 47	16 52
27	15 40	15 56	16 08	16 18	16 27	16 34	16 48	17 00	17 11	17 22	17 34	17 48	17 56	18 05
28	16 01	16 23	16 40	16 54	17 05	17 16	17 34	17 50	18 04	18 19	18 35	18 54	19 05	19 17
29	16 29	16 56	17 18	17 35	17 49	18 02	18 23	18 42	19 00	19 18	19 37	19 59	20 12	20 27
30	17 07	17 39	18 03	18 22	18 38	18 52	19 16	19 36	19 56	20 15	20 36	21 00	21 14	21 31
May 1	17 58	18 31	18 56	19 15	19 32	19 46	20 11	20 32	20 51	21 11	21 32	21 56	22 11	22 27
2	19 00	19 31	19 55	20 13	20 29	20 43	21 06	21 26	21 44	22 03	22 23	22 46	22 59	23 15
3	20 10	20 37	20 57	21 14	21 28	21 40	22 00	22 18	22 35	22 51	23 09	23 29	23 41	23 55
4	21 23	21 45	22 01	22 15	22 26	22 36	22 53	23 08	23 22	23 36	23 51	.. ..	.. ..	.. ..
5	22 37	22 52	23 05	23 15	23 23	23 31	23 44	23 56	.. ..	.. ..	.. ..	0 07	0 17	0 28
6	23 49	23 59	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 06	0 17	0 28	0 41	0 48	0 57
7	.. ..	.. ..	0 07	0 14	0 20	0 25	0 34	0 41	0 48	0 56	1 03	1 12	1 17	1 22
8	1 01	1 06	1 09	1 13	1 15	1 18	1 22	1 26	1 29	1 33	1 36	1 41	1 43	1 46
9	2 13	2 12	2 12	2 12	2 11	2 11	2 11	2 10	2 10	2 10	2 09	2 09	2 09	2 09
10	3 26	3 20	3 15	3 11	3 08	3 05	3 00	2 55	2 51	2 47	2 43	2 38	2 35	2 32
11	4 42	4 30	4 21	4 13	4 07	4 01	3 51	3 42	3 34	3 27	3 18	3 09	3 03	2 57
12	6 00	5 43	5 29	5 17	5 08	4 59	4 45	4 32	4 20	4 09	3 57	3 43	3 34	3 25
13	7 21	6 57	6 39	6 24	6 11	6 00	5 41	5 25	5 10	4 55	4 39	4 21	4 10	3 58
14	8 41	8 11	7 49	7 31	7 16	7 03	6 41	6 21	6 04	5 46	5 27	5 06	4 53	4 38
15	9 54	9 20	8 56	8 36	8 19	8 05	7 41	7 20	7 01	6 41	6 21	5 57	5 43	5 27
16	10 53	10 20	9 56	9 36	9 19	9 05	8 41	8 20	8 00	7 40	7 19	6 55	6 41	6 24
17	11 38	11 08	10 46	10 28	10 13	10 00	9 37	9 18	8 59	8 41	8 22	7 59	7 45	7 30
18	12 09	11 46	11 27	11 12	11 00	10 49	10 30	10 13	9 57	9 42	9 25	9 05	8 54	8 41

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	1 33	1 40	1 45	1 50	1 53	1 57	2 02	2 07	2 12	2 16	2 21	2 26	2 29	2 33
25	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 02	3 01	3 01
26	4 31	4 24	4 19	4 14	4 11	4 07	4 02	3 57	3 52	3 47	3 42	3 37	3 34	3 30
27	5 59	5 46	5 36	5 27	5 20	5 13	5 02	4 52	4 43	4 34	4 24	4 14	4 07	4 00
28	7 28	7 08	6 53	6 40	6 29	6 19	6 03	5 49	5 36	5 23	5 09	4 53	4 44	4 33
29	8 54	8 27	8 07	7 51	7 37	7 25	7 05	6 47	6 31	6 14	5 57	5 37	5 25	5 12
30	10 12	9 40	9 17	8 58	8 42	8 29	8 05	7 45	7 27	7 08	6 48	6 25	6 11	5 56
May 1	11 16	10 43	10 18	9 58	9 42	9 28	9 03	8 42	8 23	8 03	7 42	7 17	7 03	6 46
2	12 05	11 34	11 10	10 51	10 35	10 21	9 57	9 36	9 17	8 58	8 37	8 13	7 59	7 43
3	12 41	12 13	11 52	11 35	11 20	11 07	10 46	10 27	10 09	9 51	9 32	9 10	8 57	8 42
4	13 06	12 43	12 26	12 11	11 59	11 48	11 29	11 13	10 58	10 43	10 26	10 07	9 56	9 43
5	13 24	13 07	12 53	12 42	12 32	12 24	12 09	11 56	11 44	11 31	11 18	11 03	10 54	10 44
6	13 38	13 26	13 17	13 09	13 02	12 56	12 45	12 36	12 27	12 18	12 08	11 57	11 51	11 43
7	13 50	13 43	13 38	13 33	13 29	13 25	13 19	13 13	13 08	13 02	12 57	12 51	12 47	12 42
8	14 01	13 59	13 57	13 56	13 55	13 54	13 52	13 50	13 49	13 47	13 45	13 43	13 42	13 41
9	14 12	14 15	14 17	14 19	14 21	14 22	14 25	14 27	14 30	14 32	14 34	14 37	14 38	14 40
10	14 23	14 31	14 38	14 43	14 48	14 52	14 59	15 06	15 12	15 18	15 24	15 32	15 36	15 41
11	14 36	14 50	15 00	15 09	15 17	15 24	15 36	15 46	15 56	16 06	16 17	16 29	16 36	16 44
12	14 53	15 12	15 27	15 40	15 51	16 00	16 16	16 30	16 44	16 57	17 12	17 28	17 38	17 49
13	15 16	15 41	16 00	16 16	16 29	16 41	17 01	17 19	17 35	17 52	18 09	18 30	18 42	18 56
14	15 48	16 18	16 41	17 00	17 15	17 29	17 52	18 12	18 31	18 49	19 09	19 33	19 46	20 02
15	16 34	17 08	17 33	17 53	18 09	18 24	18 48	19 09	19 29	19 49	20 10	20 34	20 48	21 05
16	17 38	18 11	18 35	18 54	19 11	19 25	19 49	20 09	20 28	20 48	21 08	21 31	21 45	22 01
17	18 56	19 24	19 46	20 03	20 18	20 30	20 52	21 10	21 27	21 44	22 03	22 23	22 36	22 49
18	20 22	20 44	21 01	21 15	21 27	21 37	21 55	22 10	22 24	22 38	22 53	23 09	23 19	23 30

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	14 28	14 27	14 26	14 25	14 24	14 23	14 22	14 21	14 19	14 18	14 16	14 14	14 12	14 09
25	15 40	15 41	15 42	15 43	15 44	15 45	15 46	15 48	15 49	15 51	15 53	15 55	15 58	16 01
26	16 52	16 55	16 58	17 01	17 04	17 07	17 11	17 15	17 20	17 25	17 31	17 37	17 45	17 54
27	18 05	18 09	18 14	18 19	18 24	18 29	18 36	18 43	18 50	18 59	19 09	19 21	19 35	19 52
28	19 17	19 23	19 29	19 35	19 43	19 50	19 59	20 09	20 20	20 32	20 47	21 05	21 27	21 57
29	20 27	20 33	20 41	20 49	20 57	21 07	21 18	21 30	21 44	22 00	22 20	22 45	23 19	.. ..
30	21 31	21 38	21 46	21 55	22 05	22 15	22 27	22 41	22 57	23 16	23 39	.. ..	.. ..	0 22
May 1	22 27	22 35	22 43	22 51	23 01	23 12	23 24	23 38	23 53	.. ..	.. ..	0 10	0 59	■
2	23 15	23 22	23 29	23 38	23 47	23 56	.. ..	.. ..	.. ..	0 12	0 36	1 07	1 56	■
3	23 55	.. ..	.. ..	.. ..	.. ..	.. ..	0 07	0 20	0 34	0 51	1 11	1 36	2 11	3 15
4	.. ..	0 01	0 07	0 14	0 22	0 31	0 40	0 50	1 02	1 16	1 31	1 51	2 14	2 47
5	0 28	0 33	0 38	0 44	0 50	0 57	1 04	1 13	1 22	1 32	1 44	1 58	2 14	2 35
6	0 57	1 01	1 05	1 09	1 13	1 18	1 24	1 30	1 36	1 44	1 52	2 02	2 13	2 26
7	1 22	1 25	1 27	1 30	1 33	1 36	1 40	1 44	1 48	1 53	1 58	2 04	2 11	2 19
8	1 46	1 47	1 48	1 49	1 51	1 53	1 54	1 56	1 58	2 00	2 03	2 06	2 09	2 13
9	2 09	2 08	2 08	2 08	2 08	2 08	2 08	2 08	2 08	2 07	2 07	2 07	2 07	2 07
10	2 32	2 30	2 29	2 27	2 26	2 24	2 22	2 20	2 17	2 15	2 12	2 08	2 05	2 00
11	2 57	2 54	2 51	2 48	2 45	2 41	2 37	2 33	2 28	2 23	2 17	2 11	2 03	1 54
12	3 25	3 21	3 17	3 12	3 07	3 02	2 56	2 49	2 42	2 34	2 25	2 14	2 02	1 47
13	3 58	3 53	3 47	3 41	3 35	3 27	3 19	3 10	3 00	2 49	2 36	2 20	2 02	1 39
14	4 38	4 32	4 25	4 17	4 09	4 00	3 50	3 39	3 26	3 11	2 54	2 32	2 05	1 26
15	5 27	5 20	5 12	5 03	4 54	4 44	4 32	4 19	4 04	3 46	3 25	2 57	2 17	□
16	6 24	6 17	6 09	6 00	5 51	5 40	5 28	5 14	4 59	4 40	4 17	3 47	2 59	□
17	7 30	7 23	7 16	7 08	6 59	6 49	6 38	6 25	6 11	5 54	5 34	5 08	4 31	3 15
18	8 41	8 35	8 29	8 22	8 14	8 06	7 57	7 47	7 35	7 22	7 07	6 48	6 24	5 51

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Apr. 24	2 33	2 34	2 36	2 38	2 40	2 42	2 44	2 46	2 49	2 51	2 55	2 58	3 02	3 07
25	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 01	3 00	3 00	3 00
26	3 30	3 28	3 27	3 25	3 23	3 21	3 18	3 16	3 13	3 10	3 07	3 03	2 58	2 53
27	4 00	3 57	3 54	3 50	3 46	3 42	3 37	3 32	3 27	3 20	3 14	3 06	2 57	2 46
28	4 33	4 29	4 24	4 18	4 13	4 06	4 00	3 52	3 43	3 34	3 23	3 10	2 55	2 37
29	5 12	5 06	4 59	4 52	4 45	4 36	4 27	4 17	4 06	3 52	3 37	3 18	2 55	2 25
30	5 56	5 49	5 41	5 33	5 24	5 14	5 03	4 51	4 37	4 20	4 00	3 34	2 59	1 56
May 1	6 46	6 39	6 31	6 22	6 12	6 02	5 50	5 36	5 20	5 01	4 37	4 06	3 17	■
2	7 43	7 35	7 27	7 18	7 09	6 58	6 46	6 33	6 17	5 58	5 35	5 04	4 15	■
3	8 42	8 35	8 28	8 20	8 11	8 02	7 51	7 39	7 25	7 09	6 49	6 24	5 50	4 46
4	9 43	9 37	9 31	9 24	9 17	9 09	9 00	8 50	8 39	8 26	8 10	7 52	7 29	6 57
5	10 44	10 39	10 34	10 29	10 23	10 17	10 10	10 03	9 54	9 44	9 33	9 20	9 04	8 45
6	11 43	11 40	11 37	11 33	11 29	11 25	11 20	11 14	11 09	11 02	10 54	10 46	10 35	10 23
7	12 42	12 40	12 38	12 36	12 34	12 31	12 28	12 25	12 22	12 18	12 14	12 09	12 03	11 56
8	13 41	13 40	13 40	13 39	13 38	13 38	13 37	13 36	13 35	13 34	13 32	13 31	13 29	13 27
9	14 40	14 41	14 42	14 43	14 44	14 45	14 46	14 47	14 48	14 50	14 52	14 54	14 56	14 58
10	15 41	15 43	15 45	15 48	15 50	15 53	15 56	16 00	16 04	16 08	16 13	16 19	16 25	16 32
11	16 44	16 47	16 51	16 55	17 00	17 04	17 10	17 16	17 22	17 29	17 38	17 47	17 59	18 12
12	17 49	17 54	17 59	18 05	18 11	18 18	18 25	18 34	18 43	18 54	19 06	19 21	19 39	20 01
13	18 56	19 02	19 08	19 16	19 24	19 32	19 42	19 53	20 05	20 19	20 36	20 57	21 24	22 03
14	20 02	20 09	20 17	20 25	20 34	20 44	20 56	21 08	21 23	21 41	22 02	22 30	23 09	□
15	21 05	21 12	21 20	21 29	21 39	21 49	22 01	22 15	22 31	22 49	23 12	23 43	.. ..	□
16	22 01	22 08	22 16	22 24	22 33	22 43	22 55	23 07	23 22	23 39	.. ..	.. ..	0 30	□
17	22 49	22 56	23 02	23 10	23 17	23 26	23 35	23 46	23 58	.. ..	0 00	0 26	1 03	2 20
18	23 30	23 35	23 40	23 46	23 52	23 59	.. ..	.. ..	.. ..	0 12	0 28	0 48	1 13	1 46

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	11 38	11 08	10 46	10 28	10 13	10 00	9 37	9 18	8 59	8 41	8 22	7 59	7 45	7 30
18	12 09	11 46	11 27	11 12	11 00	10 49	10 30	10 13	9 57	9 42	9 25	9 05	8 54	8 41
19	12 32	12 15	12 01	11 50	11 40	11 32	11 17	11 04	10 52	10 40	10 27	10 12	10 04	9 54
20	12 49	12 38	12 30	12 22	12 16	12 11	12 01	11 53	11 45	11 37	11 28	11 18	11 13	11 06
21	13 03	12 59	12 55	12 52	12 49	12 46	12 42	12 38	12 35	12 31	12 27	12 23	12 21	12 18
22	13 17	13 18	13 19	13 19	13 20	13 21	13 22	13 23	13 24	13 25	13 26	13 27	13 28	13 28
23	13 30	13 37	13 43	13 47	13 52	13 55	14 02	14 07	14 13	14 18	14 24	14 31	14 34	14 39
24	13 45	13 58	14 09	14 17	14 25	14 31	14 43	14 53	15 03	15 12	15 23	15 35	15 42	15 50
25	14 04	14 23	14 38	14 50	15 01	15 10	15 27	15 41	15 54	16 08	16 22	16 39	16 49	17 00
26	14 28	14 53	15 13	15 28	15 42	15 54	16 14	16 32	16 48	17 05	17 23	17 43	17 56	18 10
27	15 01	15 31	15 54	16 13	16 28	16 42	17 05	17 25	17 43	18 02	18 22	18 46	19 00	19 15
28	15 47	16 19	16 44	17 04	17 20	17 34	17 58	18 19	18 39	18 59	19 20	19 44	19 58	20 15
29	16 44	17 17	17 41	18 00	18 16	18 30	18 54	19 14	19 34	19 53	20 13	20 37	20 51	21 07
30	17 52	18 21	18 43	19 00	19 15	19 28	19 49	20 08	20 26	20 43	21 02	21 23	21 36	21 50
31	19 05	19 29	19 47	20 02	20 14	20 25	20 43	20 59	21 14	21 29	21 45	22 04	22 14	22 26
June 1	20 20	20 37	20 51	21 03	21 12	21 21	21 36	21 48	22 00	22 12	22 25	22 39	22 47	22 57
2	21 33	21 45	21 55	22 03	22 09	22 15	22 26	22 35	22 43	22 52	23 01	23 11	23 17	23 23
3	22 45	22 51	22 57	23 01	23 05	23 09	23 15	23 20	23 25	23 29	23 35	23 40	23 44	23 48
4	23 56	23 57	23 59	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
5	.. ..	.. ..	.. ..	0 00	0 01	0 01	0 03	0 04	0 05	0 06	0 07	0 09	0 10	0 11
6	1 08	1 04	1 01	0 58	0 56	0 54	0 51	0 48	0 46	0 43	0 40	0 37	0 35	0 33
7	2 21	2 12	2 05	1 59	1 53	1 49	1 41	1 34	1 27	1 21	1 14	1 07	1 02	0 57
8	3 38	3 23	3 11	3 01	2 53	2 45	2 33	2 22	2 12	2 02	1 51	1 39	1 32	1 24
9	4 57	4 36	4 19	4 06	3 55	3 45	3 28	3 13	2 59	2 46	2 31	2 15	2 05	1 55
10	6 18	5 50	5 30	5 13	4 59	4 47	4 26	4 08	3 51	3 35	3 17	2 57	2 45	2 31

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	18 56	19 24	19 46	20 03	20 18	20 30	20 52	21 10	21 27	21 44	22 03	22 23	22 36	22 49
18	20 22	20 44	21 01	21 15	21 27	21 37	21 55	22 10	22 24	22 38	22 53	23 09	23 19	23 30
19	21 51	22 07	22 18	22 28	22 37	22 44	22 56	23 07	23 17	23 28	23 38	23 50	23 57	.. ..
20	23 20	23 28	23 35	23 40	23 45	23 49	23 57	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 05
21	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 03	0 09	0 14	0 20	0 27	0 31	0 36
22	0 47	0 49	0 50	0 51	0 53	0 54	0 55	0 57	0 58	0 59	1 01	1 02	1 03	1 04
23	2 13	2 09	2 05	2 02	2 00	1 57	1 53	1 50	1 47	1 44	1 40	1 36	1 34	1 32
24	3 39	3 28	3 20	3 13	3 07	3 01	2 52	2 44	2 36	2 29	2 21	2 12	2 06	2 00
25	5 06	4 48	4 35	4 23	4 14	4 06	3 51	3 39	3 27	3 15	3 03	2 49	2 41	2 32
26	6 31	6 07	5 49	5 34	5 21	5 10	4 51	4 35	4 20	4 05	3 49	3 30	3 19	3 07
27	7 51	7 22	6 59	6 42	6 27	6 14	5 51	5 32	5 14	4 57	4 38	4 16	4 03	3 48
28	9 01	8 29	8 04	7 45	7 28	7 14	6 50	6 30	6 10	5 51	5 30	5 06	4 52	4 36
29	9 57	9 24	9 00	8 40	8 24	8 10	7 46	7 25	7 05	6 46	6 25	6 01	5 46	5 30
30	10 38	10 08	9 46	9 28	9 13	9 00	8 37	8 17	7 59	7 40	7 21	6 58	6 44	6 29
31	11 07	10 42	10 23	10 08	9 55	9 43	9 23	9 06	8 50	8 33	8 16	7 55	7 43	7 30
June 1	11 28	11 09	10 54	10 41	10 30	10 21	10 05	9 50	9 37	9 23	9 09	8 52	8 42	8 31
2	11 44	11 30	11 19	11 10	11 02	10 54	10 42	10 31	10 21	10 11	10 00	9 47	9 40	9 32
3	11 57	11 48	11 41	11 35	11 30	11 25	11 17	11 10	11 03	10 57	10 50	10 41	10 36	10 31
4	12 08	12 04	12 01	11 58	11 56	11 54	11 50	11 47	11 44	11 41	11 38	11 34	11 32	11 30
5	12 18	12 19	12 20	12 21	12 21	12 22	12 23	12 24	12 24	12 25	12 26	12 27	12 27	12 28
6	12 29	12 35	12 40	12 44	12 48	12 51	12 56	13 01	13 05	13 10	13 15	13 20	13 24	13 27
7	12 41	12 53	13 02	13 09	13 16	13 21	13 31	13 40	13 48	13 57	14 06	14 16	14 22	14 28
8	12 56	13 13	13 26	13 37	13 47	13 55	14 10	14 22	14 34	14 46	14 59	15 13	15 22	15 32
9	13 16	13 38	13 56	14 11	14 23	14 34	14 52	15 08	15 24	15 39	15 55	16 14	16 25	16 38
10	13 44	14 12	14 34	14 51	15 06	15 19	15 41	16 00	16 17	16 35	16 55	17 17	17 30	17 45

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

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UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	7 30	7 23	7 16	7 08	6 59	6 49	6 38	6 25	6 11	5 54	5 34	5 08	4 31	3 15
18	8 41	8 35	8 29	8 22	8 14	8 06	7 57	7 47	7 35	7 22	7 07	6 48	6 24	5 51
19	9 54	9 49	9 44	9 39	9 34	9 28	9 21	9 14	9 05	8 56	8 45	8 32	8 17	7 59
20	11 06	11 03	11 00	10 57	10 53	10 50	10 45	10 41	10 36	10 30	10 23	10 16	10 07	9 56
21	12 18	12 16	12 15	12 14	12 12	12 11	12 09	12 07	12 04	12 02	11 59	11 56	11 53	11 48
22	13 28	13 29	13 29	13 30	13 30	13 31	13 31	13 32	13 32	13 33	13 34	13 35	13 36	13 37
23	14 39	14 41	14 43	14 45	14 48	14 50	14 53	14 56	15 00	15 04	15 08	15 14	15 19	15 26
24	15 50	15 53	15 57	16 01	16 06	16 10	16 16	16 22	16 28	16 35	16 44	16 54	17 05	17 19
25	17 00	17 05	17 11	17 17	17 23	17 30	17 38	17 46	17 56	18 07	18 20	18 35	18 53	19 17
26	18 10	18 16	18 23	18 30	18 38	18 47	18 57	19 08	19 21	19 36	19 54	20 15	20 44	21 26
27	19 15	19 23	19 30	19 39	19 48	19 58	20 10	20 23	20 38	20 56	21 18	21 47	22 29	■
28	20 15	20 23	20 31	20 39	20 49	21 00	21 12	21 26	21 42	22 01	22 24	22 56	23 47	■
29	21 07	21 14	21 22	21 30	21 39	21 50	22 01	22 14	22 29	22 47	23 08	23 36	.. ..	■
30	21 50	21 56	22 03	22 11	22 19	22 28	22 38	22 49	23 02	23 17	23 34	23 56	0 16	■
31	22 26	22 32	22 37	22 44	22 50	22 58	23 06	23 15	23 25	23 37	23 50	.. ..	0 23	1 03
June 1	22 57	23 01	23 06	23 10	23 16	23 21	23 27	23 34	23 42	23 50	.. ..	0 06	0 25	0 49
2	23 23	23 26	23 30	23 33	23 37	23 40	23 45	23 49	23 54	.. ..	0 00	0 11	0 24	0 40
3	23 48	23 49	23 51	23 53	23 55	23 57	.. ..	.. ..	.. ..	0 00	0 07	0 14	0 22	0 32
4	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 00	0 02	0 05	0 08	0 12	0 16	0 20	0 26
5	0 11	0 11	0 11	0 12	0 12	0 13	0 13	0 14	0 15	0 15	0 16	0 17	0 18	0 20
6	0 33	0 32	0 32	0 31	0 29	0 28	0 27	0 26	0 24	0 23	0 21	0 19	0 16	0 14
7	0 57	0 55	0 53	0 50	0 48	0 45	0 42	0 38	0 35	0 30	0 26	0 20	0 14	0 07
8	1 24	1 20	1 17	1 13	1 08	1 04	0 59	0 53	0 47	0 40	0 32	0 23	0 13	⁰⁰ _{23 53}
9	1 55	1 50	1 45	1 39	1 33	1 27	1 19	1 12	1 03	0 53	0 41	0 28	0 13	23 44
10	2 31	2 25	2 19	2 12	2 04	1 56	1 47	1 36	1 25	1 12	0 56	0 37	0 14	23 22

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
May 17	22 49	22 56	23 02	23 10	23 17	23 26	23 35	23 46	23 58	.. ..	0 00	0 26	1 03	2 20
18	23 30	23 35	23 40	23 46	23 52	23 59	.. ..	.. ..	.. ..	0 12	0 28	0 48	1 13	1 46
19	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	0 06	0 14	0 23	0 33	0 45	0 59	1 15	1 35
20	0 05	0 08	0 12	0 16	0 20	0 25	0 30	0 35	0 41	0 48	0 56	1 05	1 15	1 27
21	0 36	0 38	0 40	0 42	0 44	0 47	0 49	0 52	0 56	0 59	1 04	1 08	1 14	1 20
22	1 04	1 04	1 05	1 05	1 06	1 06	1 07	1 08	1 08	1 09	1 10	1 11	1 12	1 13
23	1 32	1 31	1 29	1 28	1 27	1 25	1 24	1 22	1 20	1 18	1 16	1 13	1 10	1 07
24	2 00	1 58	1 55	1 52	1 49	1 45	1 42	1 37	1 33	1 28	1 22	1 16	1 08	1 00
25	2 32	2 28	2 23	2 18	2 13	2 08	2 02	1 55	1 48	1 40	1 30	1 20	1 07	0 52
26	3 07	3 02	2 56	2 49	2 43	2 35	2 27	2 18	2 07	1 56	1 42	1 26	1 07	0 42
27	3 48	3 42	3 34	3 27	3 18	3 09	2 59	2 47	2 34	2 19	2 01	1 38	1 09	0 26
28	4 36	4 28	4 21	4 12	4 03	3 52	3 40	3 27	3 12	2 54	2 31	2 03	1 20	■
29	5 30	5 22	5 14	5 05	4 56	4 45	4 33	4 19	4 03	3 44	3 21	2 49	1 58	■
30	6 29	6 21	6 14	6 06	5 56	5 46	5 35	5 22	5 08	4 50	4 29	4 02	3 22	■
31	7 30	7 23	7 17	7 10	7 02	6 53	6 43	6 33	6 20	6 06	5 49	5 28	5 01	4 22
June 1	8 31	8 26	8 21	8 15	8 09	8 02	7 54	7 46	7 36	7 25	7 12	6 57	6 39	6 16
2	9 32	9 28	9 24	9 20	9 15	9 10	9 04	8 58	8 51	8 43	8 35	8 24	8 12	7 58
3	10 31	10 29	10 26	10 23	10 20	10 17	10 13	10 10	10 05	10 00	9 55	9 49	9 41	9 33
4	11 30	11 28	11 27	11 26	11 25	11 23	11 22	11 20	11 18	11 16	11 13	11 11	11 07	11 04
5	12 28	12 28	12 28	12 29	12 29	12 29	12 30	12 30	12 31	12 31	12 32	12 32	12 33	12 34
6	13 27	13 29	13 31	13 32	13 34	13 36	13 39	13 41	13 44	13 47	13 51	13 55	14 00	14 05
7	14 28	14 31	14 34	14 38	14 42	14 46	14 50	14 55	15 00	15 06	15 13	15 21	15 30	15 41
8	15 32	15 36	15 41	15 46	15 51	15 57	16 04	16 11	16 19	16 29	16 39	16 52	17 06	17 24
9	16 38	16 43	16 50	16 56	17 03	17 11	17 20	17 30	17 41	17 54	18 09	18 27	18 49	19 19
10	17 45	17 51	17 59	18 07	18 15	18 25	18 36	18 48	19 02	19 18	19 37	20 02	20 36	21 35

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	3 38	3 23	3 11	3 01	2 53	2 45	2 33	2 22	2 12	2 02	1 51	1 39	1 32	1 24
9	4 57	4 36	4 19	4 06	3 55	3 45	3 28	3 13	2 59	2 46	2 31	2 15	2 05	1 55
10	6 18	5 50	5 30	5 13	4 59	4 47	4 26	4 08	3 51	3 35	3 17	2 57	2 45	2 31
11	7 35	7 03	6 39	6 20	6 04	5 50	5 26	5 06	4 47	4 28	4 08	3 45	3 32	3 16
12	8 42	8 08	7 43	7 23	7 06	6 52	6 28	6 06	5 47	5 27	5 06	4 42	4 27	4 11
13	9 33	9 02	8 39	8 20	8 04	7 50	7 27	7 07	6 48	6 29	6 08	5 45	5 31	5 15
14	10 10	9 45	9 25	9 09	8 55	8 43	8 22	8 05	7 48	7 31	7 13	6 52	6 40	6 26
15	10 36	10 17	10 02	9 49	9 39	9 29	9 13	8 59	8 46	8 32	8 18	8 01	7 52	7 41
16	10 55	10 43	10 33	10 24	10 17	10 10	9 59	9 49	9 40	9 31	9 21	9 09	9 03	8 55
17	11 11	11 04	10 59	10 55	10 51	10 48	10 42	10 37	10 32	10 27	10 22	10 16	10 12	10 09
18	11 24	11 24	11 24	11 23	11 23	11 23	11 22	11 22	11 21	11 21	11 21	11 21	11 20	11 20
19	11 38	11 43	11 47	11 51	11 54	11 57	12 02	12 06	12 10	12 15	12 19	12 24	12 27	12 31
20	11 52	12 03	12 12	12 20	12 26	12 32	12 42	12 51	12 59	13 08	13 17	13 28	13 34	13 41
21	12 09	12 26	12 40	12 51	13 01	13 10	13 24	13 37	13 50	14 02	14 16	14 31	14 40	14 50
22	12 31	12 54	13 12	13 27	13 40	13 51	14 10	14 26	14 42	14 58	15 15	15 34	15 46	15 59
23	13 00	13 29	13 51	14 08	14 23	14 36	14 58	15 18	15 36	15 54	16 13	16 36	16 49	17 05
24	13 40	14 12	14 37	14 56	15 12	15 26	15 50	16 11	16 30	16 50	17 11	17 35	17 49	18 06
25	14 33	15 06	15 30	15 50	16 06	16 20	16 45	17 05	17 25	17 44	18 05	18 29	18 43	19 00
26	15 37	16 07	16 30	16 49	17 04	17 17	17 40	17 59	18 18	18 36	18 55	19 18	19 31	19 46
27	16 49	17 14	17 34	17 50	18 03	18 15	18 34	18 52	19 08	19 24	19 41	20 00	20 12	20 25
28	18 03	18 23	18 38	18 51	19 02	19 11	19 27	19 42	19 55	20 08	20 22	20 38	20 47	20 57
29	19 17	19 31	19 42	19 52	20 00	20 07	20 19	20 29	20 39	20 49	20 59	21 11	21 18	21 25
30	20 29	20 38	20 45	20 51	20 56	21 00	21 08	21 15	21 21	21 27	21 34	21 41	21 46	21 50
July 1	21 40	21 44	21 47	21 49	21 51	21 53	21 56	21 59	22 01	22 04	22 07	22 10	22 12	22 14
2	22 51	22 50	22 48	22 47	22 46	22 45	22 44	22 43	22 42	22 40	22 39	22 38	22 37	22 36

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	12 56	13 13	13 26	13 37	13 47	13 55	14 10	14 22	14 34	14 46	14 59	15 13	15 22	15 32
9	13 16	13 38	13 56	14 11	14 23	14 34	14 52	15 08	15 24	15 39	15 55	16 14	16 25	16 38
10	13 44	14 12	14 34	14 51	15 06	15 19	15 41	16 00	16 17	16 35	16 55	17 17	17 30	17 45
11	14 24	14 57	15 21	15 40	15 57	16 11	16 35	16 56	17 15	17 35	17 56	18 20	18 34	18 50
12	15 21	15 55	16 20	16 40	16 56	17 11	17 35	17 56	18 16	18 35	18 56	19 20	19 34	19 51
13	16 36	17 07	17 30	17 48	18 03	18 16	18 39	18 58	19 17	19 35	19 54	20 16	20 29	20 43
14	18 03	18 27	18 46	19 01	19 14	19 25	19 44	20 00	20 16	20 31	20 47	21 05	21 16	21 28
15	19 34	19 51	20 05	20 16	20 26	20 34	20 48	21 00	21 12	21 23	21 35	21 49	21 57	22 06
16	21 05	21 15	21 24	21 30	21 36	21 41	21 50	21 58	22 05	22 12	22 20	22 28	22 33	22 38
17	22 34	22 37	22 40	22 43	22 45	22 47	22 50	22 53	22 56	22 58	23 01	23 04	23 06	23 08
18	...	23 58	23 56	23 54	23 52	23 51	23 49	23 47	23 45	23 43	23 41	23 38	23 37	23 35
19	0 00	...	...	...	...	...	...	...	...	...	...	...	...	...
20	1 26	1 17	1 10	1 04	0 59	0 54	0 47	0 40	0 34	0 27	0 21	0 13	0 09	0 04
21	2 51	2 36	2 24	2 14	2 05	1 58	1 45	1 34	1 23	1 13	1 02	0 49	0 42	0 34
22	4 16	3 54	3 37	3 23	3 11	3 01	2 44	2 29	2 14	2 00	1 45	1 28	1 18	1 07
23	5 36	5 09	4 48	4 31	4 16	4 04	3 43	3 25	3 08	2 50	2 32	2 11	1 59	1 45
24	6 49	6 18	5 54	5 35	5 19	5 05	4 41	4 21	4 02	3 43	3 23	2 59	2 46	2 30
25	7 50	7 17	6 52	6 32	6 16	6 02	5 37	5 16	4 57	4 37	4 16	3 52	3 37	3 21
26	8 35	8 05	7 41	7 22	7 07	6 53	6 30	6 09	5 51	5 31	5 11	4 47	4 33	4 17
27	9 08	8 42	8 22	8 54	8 05	7 51	7 39	7 18	6 59	6 42	6 25	6 06	5 45	5 18
28	9 32	9 11	8 54	8 41	8 29	8 19	8 01	7 45	7 31	7 16	7 00	6 42	6 31	6 19
29	9 50	9 34	9 21	9 11	9 02	8 54	8 40	8 28	8 16	8 05	7 52	7 38	7 30	7 20
30	10 04	9 53	9 44	9 37	9 31	9 25	9 16	9 07	8 59	8 51	8 43	8 33	8 27	8 20
July 1	10 15	10 10	10 05	10 01	9 58	9 55	9 50	9 45	9 40	9 36	9 31	9 26	9 23	9 19
2	10 26	10 25	10 24	10 24	10 23	10 23	10 22	10 21	10 21	10 20	10 19	10 18	10 18	10 17

... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

47

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	1 24	1 20	1 17	1 13	1 08	1 04	0 59	0 53	0 47	0 40	0 32	0 23	0 13	^(00 01) 23 44
9	1 55	1 50	1 45	1 39	1 33	1 27	1 19	1 12	1 03	0 53	0 41	0 28	0 13	23 44
10	2 31	2 25	2 19	2 12	2 04	1 56	1 47	1 36	1 25	1 12	0 56	0 37	0 14	23 22
11	3 16	3 09	3 02	2 54	2 45	2 35	2 24	2 12	1 57	1 41	1 21	0 56	0 21	□
12	4 11	4 03	3 55	3 47	3 37	3 26	3 15	3 01	2 45	2 27	2 04	1 34	0 48	□
13	5 15	5 08	5 00	4 52	4 42	4 32	4 20	4 07	3 52	3 34	3 13	2 44	2 03	□
14	6 26	6 20	6 13	6 06	5 58	5 49	5 39	5 28	5 15	5 01	4 43	4 21	3 53	3 12
15	7 41	7 36	7 30	7 25	7 18	7 12	7 04	6 56	6 46	6 36	6 23	6 09	5 51	5 29
16	8 55	8 52	8 48	8 45	8 40	8 36	8 31	8 25	8 19	8 12	8 04	7 55	7 45	7 32
17	10 09	10 07	10 05	10 03	10 01	9 59	9 56	9 53	9 50	9 47	9 43	9 39	9 34	9 28
18	11 20	11 20	11 20	11 20	11 20	11 20	11 20	11 19	11 19	11 19	11 19	11 19	11 19	11 18
19	12 31	12 32	12 34	12 36	12 37	12 39	12 42	12 44	12 47	12 50	12 53	12 57	13 02	13 07
20	13 41	13 44	13 47	13 51	13 54	13 59	14 03	14 08	14 14	14 20	14 27	14 36	14 45	14 57
21	14 50	14 55	15 00	15 05	15 11	15 17	15 24	15 32	15 41	15 50	16 02	16 15	16 31	16 51
22	15 59	16 05	16 11	16 18	16 26	16 34	16 43	16 53	17 05	17 19	17 35	17 54	18 19	18 53
23	17 05	17 12	17 19	17 27	17 36	17 46	17 57	18 10	18 24	18 41	19 02	19 28	20 06	■
24	18 06	18 13	18 21	18 30	18 40	18 50	19 02	19 16	19 32	19 51	20 14	20 46	21 36	■
25	19 00	19 07	19 15	19 24	19 33	19 44	19 56	20 09	20 25	20 43	21 06	21 36	22 21	■
26	19 46	19 53	20 00	20 08	20 17	20 26	20 37	20 49	21 02	21 18	21 38	22 01	22 33	23 24
27	20 25	20 31	20 37	20 43	20 51	20 59	21 08	21 18	21 29	21 42	21 56	22 14	22 36	23 05
28	20 57	21 02	21 07	21 12	21 18	21 24	21 31	21 39	21 48	21 57	22 08	22 21	22 36	22 54
29	21 25	21 29	21 32	21 36	21 41	21 45	21 50	21 56	22 02	22 08	22 16	22 25	22 35	22 47
30	21 50	21 53	21 55	21 57	22 00	22 03	22 06	22 09	22 13	22 17	22 22	22 27	22 33	22 40
July 1	22 14	22 14	22 15	22 16	22 18	22 19	22 20	22 21	22 23	22 25	22 26	22 29	22 31	22 34
2	22 36	22 36	22 35	22 35	22 34	22 34	22 33	22 33	22 32	22 31	22 31	22 30	22 29	22 28

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
June 8	15 32	15 36	15 41	15 46	15 51	15 57	16 04	16 11	16 19	16 29	16 39	16 52	17 06	17 24
9	16 38	16 43	16 50	16 56	17 03	17 11	17 20	17 30	17 41	17 54	18 09	18 27	18 49	19 19
10	17 45	17 51	17 59	18 07	18 15	18 25	18 36	18 48	19 02	19 18	19 37	20 02	20 36	21 35
11	18 50	18 58	19 05	19 14	19 24	19 34	19 46	20 00	20 15	20 34	20 56	21 26	22 12	□
12	19 51	19 58	20 06	20 14	20 24	20 34	20 46	20 59	21 14	21 33	21 55	22 23	23 05	□
13	20 43	20 50	20 57	21 05	21 13	21 22	21 33	21 44	21 57	22 12	22 30	22 52	23 21	□
14	21 28	21 33	21 39	21 45	21 52	21 59	22 08	22 17	22 27	22 38	22 51	23 07	23 25	^(00 03) 23 40
15	22 06	22 10	22 14	22 18	22 23	22 28	22 34	22 40	22 47	22 55	23 04	23 14	23 26	23 40
16	22 38	22 41	22 43	22 46	22 49	22 52	22 55	22 59	23 03	23 08	23 13	23 19	23 25	23 33
17	23 08	23 08	23 09	23 10	23 11	23 12	23 14	23 15	23 16	23 18	23 20	23 22	23 24	23 26
18	23 35	23 35	23 34	23 33	23 32	23 32	23 31	23 30	23 28	23 27	23 26	23 24	23 22	23 20
19	.. ..	.. ..	23 59	23 57	23 54	23 51	23 48	23 44	23 41	23 37	23 32	23 27	23 20	23 13
20	0 04	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 47	23 39	23 30	23 19	23 06
21	0 34	0 30	0 26	0 22	0 17	0 12	0 07	0 01	.. ..	.. ..	23 50	23 35	23 18	22 58
22	1 07	1 02	0 56	0 51	0 44	0 38	0 30	0 22	0 12	0 02	.. ..	23 45	23 20	22 45
23	1 45	1 39	1 32	1 25	1 17	1 08	0 59	0 48	0 36	0 22	0 05	.. ..	23 26	■
24	2 30	2 23	2 15	2 07	1 57	1 47	1 36	1 23	1 09	0 51	0 30	0 04	23 50	■
25	3 21	3 13	3 05	2 56	2 47	2 36	2 24	2 10	1 54	1 35	1 12	0 40	.. ..	■
26	4 17	4 10	4 02	3 54	3 44	3 34	3 22	3 09	2 53	2 35	2 13	1 43	0 58	■
27	5 18	5 11	5 04	4 56	4 48	4 39	4 28	4 17	4 03	3 48	3 29	3 06	2 34	1 44
28	6 19	6 14	6 08	6 01	5 54	5 47	5 38	5 29	5 18	5 06	4 52	4 35	4 13	3 46
29	7 20	7 16	7 12	7 07	7 01	6 56	6 49	6 42	6 34	6 25	6 15	6 03	5 49	5 31
30	8 20	8 17	8 14	8 11	8 07	8 03	7 59	7 54	7 49	7 43	7 36	7 29	7 20	7 09
July 1	9 19	9 17	9 16	9 14	9 12	9 10	9 08	9 05	9 02	8 59	8 55	8 51	8 47	8 41
2	10 17	10 17	10 17	10 16	10 16	10 16	10 15	10 15	10 14	10 14	10 13	10 13	10 12	10 11

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	21 40	21 44	21 47	21 49	21 51	21 53	21 56	21 59	22 01	22 04	22 07	22 10	22 12	22 14
2	22 51	22 50	22 48	22 47	22 46	22 45	22 44	22 43	22 42	22 40	22 39	22 38	22 37	22 36
3	.. ..	23 56	23 51	23 46	23 42	23 39	23 32	23 27	23 22	23 17	23 12	23 06	23 03	22 59
4	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 56	23 47	23 37	23 31	23 24
5	1 17	1 05	0 55	0 46	0 39	0 33	0 23	0 13	0 05	.. ..	.. ..	.. ..	.. ..	23 52
6	2 34	2 15	2 01	1 49	1 39	1 30	1 15	1 02	0 50	0 38	0 25	0 10	0 02	.. ..
7	3 53	3 28	3 09	2 54	2 41	2 30	2 11	1 54	1 39	1 23	1 07	0 49	0 38	0 25
8	5 11	4 41	4 18	4 00	3 45	3 32	3 09	2 50	2 32	2 14	1 55	1 33	1 20	1 06
9	6 23	5 50	5 25	5 05	4 48	4 34	4 10	3 49	3 29	3 10	2 49	2 25	2 11	1 55
10	7 23	6 50	6 25	6 05	5 49	5 35	5 10	4 50	4 30	4 10	3 50	3 25	3 11	2 55
11	8 06	7 38	7 16	6 59	6 44	6 31	6 09	5 49	5 31	5 13	4 54	4 32	4 19	4 04
12	8 37	8 15	7 58	7 44	7 32	7 21	7 03	6 47	6 32	6 17	6 01	5 42	5 31	5 19
13	9 00	8 45	8 32	8 22	8 13	8 06	7 52	7 40	7 29	7 18	7 06	6 53	6 45	6 36
14	9 17	9 08	9 01	8 55	8 50	8 46	8 38	8 31	8 24	8 17	8 10	8 02	7 57	7 52
15	9 32	9 29	9 27	9 25	9 24	9 22	9 20	9 18	9 16	9 14	9 12	9 10	9 08	9 07
16	9 46	9 49	9 52	9 54	9 56	9 58	10 01	10 04	10 06	10 09	10 12	10 15	10 17	10 20
17	10 00	10 09	10 17	10 23	10 29	10 33	10 42	10 49	10 56	11 04	11 11	11 20	11 25	11 31
18	10 16	10 32	10 44	10 54	11 03	11 11	11 24	11 36	11 47	11 58	12 10	12 24	12 32	12 42
19	10 36	10 58	11 15	11 28	11 40	11 50	12 08	12 24	12 39	12 54	13 09	13 28	13 39	13 51
20	11 03	11 30	11 51	12 08	12 22	12 34	12 56	13 14	13 32	13 49	14 08	14 30	14 43	14 58
21	11 39	12 10	12 34	12 53	13 09	13 23	13 46	14 07	14 26	14 45	15 05	15 29	15 43	16 00
22	12 27	13 00	13 24	13 44	14 01	14 15	14 39	15 00	15 20	15 39	16 00	16 25	16 39	16 55
23	13 27	13 58	14 22	14 41	14 56	15 10	15 33	15 54	16 12	16 31	16 51	17 14	17 28	17 44
24	14 36	15 03	15 24	15 41	15 55	16 07	16 28	16 46	17 03	17 20	17 38	17 58	18 11	18 24
25	15 49	16 11	16 28	16 42	16 53	17 04	17 21	17 36	17 51	18 05	18 20	18 37	18 47	18 59

MOONSET

July	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	10 15	10 10	10 05	10 01	9 58	9 55	9 50	9 45	9 40	9 36	9 31	9 26	9 23	9 19
2	10 26	10 25	10 24	10 24	10 23	10 23	10 22	10 21	10 21	10 20	10 19	10 18	10 18	10 17
3	10 37	10 41	10 44	10 47	10 49	10 51	10 55	10 58	11 01	11 04	11 07	11 11	11 13	11 15
4	10 48	10 57	11 04	11 10	11 16	11 20	11 28	11 36	11 42	11 49	11 56	12 05	12 09	12 15
5	11 01	11 15	11 27	11 36	11 45	11 52	12 05	12 16	12 26	12 36	12 48	13 00	13 08	13 16
6	11 18	11 38	11 54	12 07	12 18	12 28	12 44	12 59	13 13	13 27	13 41	13 59	14 08	14 20
7	11 41	12 07	12 27	12 43	12 57	13 09	13 29	13 47	14 04	14 20	14 38	14 59	15 11	15 25
8	12 14	12 45	13 09	13 27	13 43	13 57	14 20	14 40	14 59	15 18	15 38	16 01	16 15	16 31
9	13 03	13 37	14 02	14 22	14 38	14 53	15 17	15 38	15 58	16 18	16 39	17 03	17 17	17 34
10	14 10	14 42	15 07	15 26	15 42	15 56	16 20	16 40	16 59	17 18	17 38	18 02	18 15	18 31
11	15 33	16 01	16 22	16 38	16 53	17 05	17 26	17 44	18 00	18 17	18 35	18 55	19 07	19 20
12	17 05	17 26	17 42	17 55	18 06	18 16	18 32	18 46	18 59	19 13	19 27	19 42	19 51	20 02
13	18 40	18 53	19 03	19 12	19 19	19 26	19 37	19 47	19 56	20 04	20 14	20 24	20 31	20 37
14	20 12	20 19	20 24	20 28	20 31	20 34	20 40	20 45	20 49	20 53	20 58	21 03	21 06	21 09
15	21 43	21 42	21 42	21 42	21 41	21 41	21 41	21 40	21 40	21 40	21 39	21 39	21 38	21 38
16	23 11	23 04	22 58	22 54	22 50	22 46	22 40	22 35	22 30	22 25	22 20	22 14	22 11	22 07
17	.. ..	.. ..	.. ..	.. ..	23 57	23 51	23 40	23 30	23 20	23 11	23 01	22 50	22 44	22 37
18	0 38	0 24	0 14	0 05	.. ..	.. ..	.. ..	.. ..	.. ..	23 58	23 45	23 29	23 19	23 09
19	2 03	1 43	1 28	1 15	1 04	0 55	0 39	0 25	0 11	.. ..	.. ..	.. ..	23 59	23 46
20	3 25	2 59	2 39	2 23	2 10	1 58	1 38	1 20	1 04	0 48	0 30	0 11	.. ..	.. ..
21	4 40	4 10	3 46	3 28	3 12	2 59	2 36	2 16	1 58	1 39	1 19	0 57	0 43	0 28
22	5 44	5 11	4 47	4 27	4 11	3 56	3 32	3 11	2 52	2 32	2 11	1 47	1 33	1 16
23	6 34	6 02	5 38	5 19	5 03	4 49	4 25	4 05	3 45	3 26	3 05	2 41	2 27	2 10
24	7 11	6 43	6 21	6 04	5 49	5 36	5 14	4 55	4 37	4 19	4 00	3 37	3 24	3 09
25	7 37	7 14	6 56	6 41	6 29	6 17	5 59	5 42	5 26	5 11	4 54	4 34	4 23	4 10

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56	+58	+60	+62'	+64	+66
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 1	22 14	22 14	22 15	22 16	22 18	22 19	22 20	22 21	22 23	22 25	22 26	22 29	22 31	22 34
2	22 36	22 36	22 35	22 35	22 34	22 34	22 33	22 33	22 32	22 31	22 31	22 30	22 29	22 28
3	22 59	22 58	22 56	22 54	22 52	22 50	22 47	22 45	22 42	22 39	22 35	22 31	22 27	22 22
4	23 24	23 21	23 18	23 15	23 11	23 07	23 03	22 58	22 53	22 47	22 41	22 34	22 25	22 15
5	23 52	23 48	23 43	23 39	23 33	23 28	23 21	23 15	23 07	22 58	22 49	22 37	22 24	22 08
6	.. ..	.. ..	.. ..	.. ..	.. ..	23 53	23 45	23 36	23 25	23 14	23 00	22 44	22 25	22 00
7	0 25	0 20	0 14	0 08	0 01	.. ..	.. ..	.. ..	23 52	23 37	23 19	22 57	22 28	21 46
8	1 06	0 59	0 52	0 44	0 36	0 27	0 17	0 05	.. ..	.. ..	23 52	23 23	22 42	□
9	1 55	1 48	1 40	1 31	1 22	1 12	1 00	0 47	0 32	0 14	.. ..	.. ..	23 31	□
10	2 55	2 47	2 39	2 31	2 21	2 10	1 58	1 45	1 29	1 11	0 48	0 17	.. ..	□
11	4 04	3 57	3 49	3 41	3 33	3 23	3 12	3 00	2 46	2 30	2 10	1 45	1 10	0 08
12	5 19	5 13	5 07	5 00	4 53	4 45	4 37	4 27	4 16	4 04	3 49	3 31	3 09	2 40
13	6 36	6 32	6 27	6 23	6 17	6 12	6 06	5 59	5 52	5 43	5 33	5 22	5 09	4 52
14	7 52	7 50	7 47	7 44	7 41	7 38	7 35	7 31	7 27	7 22	7 17	7 10	7 03	6 55
15	9 07	9 06	9 05	9 05	9 04	9 03	9 02	9 01	9 00	8 58	8 57	8 55	8 53	8 51
16	10 20	10 21	10 22	10 23	10 24	10 25	10 27	10 28	10 30	10 32	10 34	10 37	10 40	10 43
17	11 31	11 34	11 37	11 40	11 43	11 46	11 50	11 54	11 59	12 04	12 10	12 17	12 25	12 35
18	12 42	12 46	12 50	12 55	13 00	13 06	13 12	13 19	13 27	13 36	13 46	13 58	14 11	14 28
19	13 51	13 57	14 03	14 09	14 16	14 24	14 32	14 42	14 53	15 05	15 20	15 37	15 59	16 28
20	14 58	15 04	15 11	15 19	15 28	15 37	15 48	16 00	16 13	16 30	16 49	17 13	17 46	18 43
21	16 00	16 07	16 15	16 24	16 33	16 44	16 55	17 09	17 25	17 43	18 06	18 36	19 23	■
22	16 55	17 03	17 11	17 20	17 29	17 40	17 52	18 06	18 22	18 40	19 04	19 35	20 24	■
23	17 44	17 51	17 58	18 06	18 15	18 25	18 37	18 49	19 04	19 20	19 41	20 07	20 43	21 55
24	18 24	18 31	18 37	18 44	18 52	19 01	19 10	19 21	19 33	19 47	20 03	20 23	20 48	21 22
25	18 59	19 04	19 09	19 15	19 22	19 28	19 36	19 45	19 54	20 05	20 17	20 32	20 49	21 10

MOONSET

July	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	9 19	9 17	9 16	9 14	9 12	9 10	9 08	9 05	9 02	8 59	8 55	8 51	8 47	8 41
2	10 17	10 17	10 17	10 16	10 16	10 16	10 15	10 15	10 14	10 14	10 13	10 13	10 12	10 11
3	11 15	11 17	11 18	11 19	11 20	11 22	11 23	11 25	11 27	11 29	11 31	11 34	11 37	11 41
4	12 15	12 17	12 20	12 23	12 26	12 29	12 32	12 36	12 41	12 46	12 51	12 57	13 04	13 13
5	13 16	13 20	13 24	13 28	13 33	13 38	13 44	13 50	13 57	14 05	14 14	14 24	14 36	14 51
6	14 20	14 25	14 30	14 36	14 43	14 50	14 58	15 06	15 16	15 27	15 40	15 56	16 14	16 38
7	15 25	15 32	15 39	15 46	15 54	16 03	16 13	16 24	16 36	16 51	17 09	17 30	17 58	18 39
8	16 31	16 38	16 46	16 54	17 04	17 14	17 25	17 38	17 53	18 11	18 33	19 01	19 42	□
9	17 34	17 41	17 49	17 58	18 08	18 19	18 30	18 44	19 00	19 18	19 41	20 12	20 58	□
10	18 31	18 38	18 46	18 54	19 03	19 13	19 24	19 36	19 51	20 07	20 28	20 53	21 28	22 30
11	19 20	19 26	19 33	19 40	19 47	19 55	20 05	20 15	20 26	20 39	20 55	21 13	21 36	22 06
12	20 02	20 06	20 11	20 17	20 22	20 28	20 35	20 43	20 51	21 00	21 11	21 23	21 38	21 56
13	20 37	20 40	20 44	20 47	20 51	20 55	20 59	21 04	21 09	21 15	21 22	21 29	21 38	21 48
14	21 09	21 10	21 12	21 13	21 15	21 17	21 19	21 21	21 24	21 26	21 29	21 33	21 37	21 41
15	21 38	21 38	21 38	21 38	21 37	21 37	21 37	21 37	21 37	21 36	21 36	21 36	21 35	21 35
16	22 07	22 05	22 03	22 01	21 59	21 57	21 55	21 52	21 49	21 46	21 42	21 38	21 33	21 28
17	22 37	22 33	22 30	22 26	22 22	22 18	22 13	22 08	22 03	21 56	21 49	21 41	21 32	21 21
18	23 09	23 04	22 59	22 54	22 48	22 42	22 35	22 28	22 19	22 10	21 59	21 46	21 31	21 13
19	23 46	23 40	23 33	23 27	23 19	23 11	23 02	22 52	22 40	22 27	22 12	21 54	21 32	21 02
20	.. ..	.. ..	.. ..	.. ..	23 57	23 47	23 36	23 24	23 10	22 53	22 34	22 09	21 36	20 39
21	0 28	0 21	0 14	0 05	.. ..	.. ..	.. ..	.. ..	23 51	23 32	23 09	22 39	21 51	■
22	1 16	1 09	1 01	0 52	0 42	0 32	0 20	0 06	.. ..	.. ..	.. ..	23 32	22 43	■
23	2 10	2 03	1 55	1 46	1 37	1 26	1 14	1 01	0 45	0 26	0 03	.. ..	.. ..	23 01
24	3 09	3 02	2 55	2 47	2 38	2 28	2 17	2 05	1 51	1 34	1 14	0 48	0 13	.. ..
25	4 10	4 04	3 58	3 51	3 43	3 35	3 26	3 16	3 04	2 51	2 35	2 15	1 51	1 18

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	−55°	−50°	−45°	−40°	−35°	−30°	−20°	−10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	14 36	15 03	15 24	15 41	15 55	16 07	16 28	16 46	17 03	17 20	17 38	17 58	18 11	18 24
	25	15 49	16 11	16 28	16 42	16 53	17 04	17 21	17 36	17 51	18 05	18 20	18 37	18 59
	26	17 03	17 19	17 32	17 42	17 51	17 59	18 13	18 25	18 36	18 47	18 58	19 12	19 28
	27	18 15	18 26	18 35	18 42	18 48	18 53	19 03	19 11	19 18	19 26	19 34	19 43	19 54
	28	19 27	19 33	19 37	19 41	19 44	19 47	19 51	19 55	19 59	20 03	20 07	20 12	20 18
	29	20 38	20 38	20 38	20 39	20 39	20 39	20 39	20 40	20 40	20 40	20 40	20 40	20 41
	30	21 49	21 44	21 40	21 37	21 34	21 31	21 27	21 23	21 20	21 16	21 13	21 08	21 03
	31	23 01	22 51	22 43	22 36	22 30	22 25	22 16	22 08	22 01	21 54	21 46	21 38	21 27
	Aug. 1	...	...	23 47	23 36	23 28	23 20	23 07	22 55	22 44	22 34	22 22	22 09	22 02
		2	0 16	0 00	...	...	...	...	23 45	23 30	23 16	23 02	22 45	22 35
	3	1 32	1 10	0 53	0 39	0 27	0 17	0 00	...	...	...	23 46	23 25	23 13
	4	2 49	2 21	2 00	1 43	1 29	1 17	0 56	0 37	0 20	0 04	...	...	23 59
	5	4 02	3 30	3 06	2 47	2 31	2 17	1 54	1 33	1 15	0 56	0 36	0 13	...
	6	5 07	4 33	4 08	3 48	3 32	3 17	2 53	2 32	2 12	1 53	1 32	1 07	0 53
	7	5 58	5 27	5 03	4 44	4 29	4 15	3 52	3 31	3 12	2 53	2 33	2 10	1 40
	8	6 35	6 09	5 49	5 33	5 20	5 08	4 47	4 30	4 13	3 56	3 38	3 18	3 05
	9	7 01	6 42	6 28	6 15	6 05	5 55	5 39	5 25	5 12	4 59	4 45	4 28	4 19
	10	7 21	7 09	7 00	6 51	6 44	6 38	6 27	6 18	6 09	6 00	5 51	5 40	5 33
	11	7 38	7 32	7 28	7 24	7 20	7 18	7 12	7 08	7 04	6 59	6 55	6 50	6 47
	12	7 52	7 53	7 54	7 54	7 54	7 55	7 55	7 56	7 57	7 57	7 58	7 59	8 00
	13	8 07	8 14	8 19	8 24	8 28	8 32	8 38	8 43	8 49	8 54	9 00	9 06	9 10
	14	8 23	8 36	8 46	8 55	9 03	9 09	9 21	9 31	9 41	9 50	10 01	10 13	10 20
	15	8 42	9 01	9 17	9 29	9 40	9 49	10 06	10 20	10 33	10 47	11 02	11 18	11 28
	16	9 07	9 32	9 52	10 07	10 21	10 33	10 53	11 11	11 27	11 44	12 02	12 22	12 35
	17	9 40	10 10	10 33	10 51	11 07	11 20	11 43	12 03	12 22	12 40	13 00	13 24	13 53

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	7 11	6 43	6 21	6 04	5 49	5 36	5 14	4 55	4 37	4 19	4 00	3 37	3 24	3 09
	25	7 37	7 14	6 56	6 41	6 29	6 17	5 59	5 42	5 26	5 11	4 54	4 34	4 10
	26	7 57	7 39	7 25	7 13	7 03	6 54	6 39	6 25	6 13	6 00	5 46	5 31	5 11
	27	8 12	7 59	7 49	7 47	7 33	7 27	7 16	7 06	6 57	6 47	6 36	6 26	6 11
	28	8 24	8 17	8 10	8 05	8 01	7 57	7 50	7 44	7 38	7 33	7 26	7 19	7 10
	29	8 35	8 32	8 30	8 28	8 27	8 25	8 23	8 21	8 19	8 17	8 14	8 12	8 10
	30	8 45	8 48	8 49	8 51	8 52	8 53	8 55	8 57	8 59	9 00	9 02	9 04	9 05
	31	8 56	9 03	9 09	9 14	9 18	9 22	9 28	9 34	9 39	9 45	9 50	9 57	10 01
	Aug. 1	9 09	9 21	9 31	9 39	9 46	9 52	10 03	10 12	10 21	10 30	10 40	10 51	10 58
		2	9 24	9 41	9 55	10 07	10 17	10 25	10 40	10 54	11 06	11 18	11 32	11 47
	3	9 43	10 07	10 25	10 39	10 52	11 03	11 22	11 38	11 54	12 10	12 26	12 45	12 57
	4	10 11	10 39	11 01	11 19	11 34	11 47	12 09	12 28	12 46	13 04	13 23	13 45	13 59
	5	10 51	11 23	11 48	12 07	12 23	12 38	13 02	13 22	13 42	14 01	14 22	14 46	15 00
	6	11 47	12 21	12 45	13 05	13 22	13 36	14 00	14 21	14 41	15 00	15 21	15 45	15 59
	7	13 02	13 32	13 55	14 13	14 28	14 41	15 04	15 23	15 41	15 59	16 18	16 40	16 53
	8	14 29	14 54	15 12	15 27	15 40	15 51	16 10	16 26	16 41	16 56	17 12	17 31	17 53
	9	16 04	16 21	16 34	16 45	16 54	17 02	17 16	17 28	17 39	17 51	18 02	18 16	18 23
	10	17 39	17 49	17 57	18 03	18 08	18 13	18 21	18 29	18 35	18 42	18 49	18 57	19 01
	11	19 13	19 16	19 18	19 20	19 21	19 23	19 25	19 27	19 29	19 31	19 33	19 35	19 36
	12	20 45	20 41	20 38	20 35	20 33	20 31	20 27	20 24	20 21	20 18	20 15	20 12	20 09
	13	22 16	22 05	21 57	21 49	21 43	21 38	21 29	21 21	21 13	21 06	20 58	20 49	20 43
	14	23 45	23 27	23 14	23 02	22 53	22 44	22 30	22 17	22 06	21 54	21 42	21 27	21 19
	15	...	...	...	...	...	23 49	23 30	23 14	22 59	22 44	22 28	22 09	21 58
	16	1 10	0 46	0 28	0 13	0 00	...	...	...	23 53	23 35	23 16	22 54	22 42
	17	2 29	2 00	1 38	1 20	1 05	0 52	0 30	0 11	...	...	...	23 44	23 30

... .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	18 24	18 31	18 37	18 44	18 52	19 01	19 10	19 21	19 33	19 47	20 03	20 23	20 48	21 22
25	18 59	19 04	19 09	19 15	19 22	19 28	19 36	19 45	19 54	20 05	20 17	20 32	20 49	21 10
26	19 28	19 32	19 36	19 41	19 46	19 51	19 56	20 03	20 10	20 17	20 26	20 36	20 48	21 02
27	19 54	19 57	20 00	20 03	20 06	20 09	20 13	20 17	20 22	20 27	20 33	20 39	20 46	20 55
28	20 18	20 19	20 21	20 22	20 24	20 26	20 28	20 30	20 32	20 35	20 38	20 41	20 44	20 49
29	20 41	20 41	20 41	20 41	20 41	20 41	20 41	20 41	20 42	20 42	20 42	20 42	20 42	20 43
30	21 03	21 02	21 01	21 00	20 58	20 57	20 55	20 53	20 51	20 49	20 46	20 44	20 40	20 37
31	21 27	21 25	21 22	21 19	21 16	21 13	21 10	21 06	21 02	20 57	20 52	20 46	20 39	20 31
Aug. 1	21 53	21 50	21 46	21 42	21 37	21 32	21 27	21 21	21 14	21 07	20 58	20 49	20 37	20 24
2	22 24	22 19	22 13	22 08	22 01	21 55	21 47	21 39	21 30	21 20	21 08	20 54	20 37	20 17
3	23 00	22 54	22 47	22 40	22 32	22 24	22 14	22 04	21 52	21 38	21 22	21 03	20 39	20 07
4	23 43	23 36	23 29	23 21	23 12	23 02	22 51	22 38	22 24	22 07	21 47	21 22	20 47	19 44
5	.. ..	.. ..	.. ..	.. ..	.. ..	23 52	23 41	23 27	23 11	22 53	22 30	22 00	21 15	□
6	0 37	0 29	0 21	0 13	0 03	.. ..	.. ..	.. ..	.. ..	.. ..	23 38	23 10	22 29	□
7	1 40	1 33	1 25	1 17	1 07	0 57	0 46	0 33	0 18	0 00	.. ..	.. ..	.. ..	23 40
8	2 52	2 45	2 39	2 31	2 23	2 14	2 05	1 54	1 41	1 26	1 09	0 48	0 20	.. ..
9	4 08	4 03	3 58	3 52	3 46	3 39	3 32	3 24	3 14	3 04	2 52	2 37	2 20	1 58
10	5 26	5 23	5 19	5 16	5 12	5 07	5 03	4 57	4 51	4 45	4 37	4 29	4 19	4 07
11	6 44	6 42	6 40	6 39	6 37	6 35	6 33	6 30	6 28	6 25	6 21	6 18	6 13	6 08
12	8 00	8 00	8 00	8 00	8 01	8 01	8 01	8 02	8 02	8 03	8 03	8 04	8 05	8 05
13	9 14	9 16	9 18	9 21	9 23	9 26	9 28	9 32	9 35	9 39	9 43	9 48	9 54	10 01
14	10 28	10 31	10 35	10 39	10 44	10 49	10 54	11 00	11 06	11 14	11 22	11 32	11 43	11 57
15	11 40	11 45	11 50	11 56	12 02	12 09	12 17	12 26	12 36	12 47	13 00	13 15	13 33	13 57
16	12 49	12 55	13 02	13 09	13 17	13 26	13 36	13 47	14 00	14 15	14 32	14 54	15 23	16 05
17	13 53	14 00	14 08	14 16	14 26	14 36	14 47	15 00	15 15	15 33	15 55	16 23	17 05	■

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
July 24	3 09	3 02	2 55	2 47	2 38	2 28	2 17	2 05	1 51	1 34	1 14	0 48	0 13	.. ..
25	4 10	4 04	3 58	3 51	3 43	3 35	3 26	3 16	3 04	2 51	2 35	2 15	1 51	1 18
26	5 11	5 06	5 01	4 56	4 50	4 43	4 36	4 28	4 19	4 09	3 58	3 44	3 27	3 07
27	6 11	6 08	6 04	6 00	5 56	5 51	5 46	5 41	5 35	5 28	5 20	5 10	5 00	4 47
28	7 10	7 08	7 06	7 04	7 01	6 58	6 55	6 52	6 48	6 44	6 39	6 34	6 28	6 21
29	8 09	8 08	8 07	8 06	8 05	8 04	8 03	8 02	8 01	7 59	7 57	7 56	7 53	7 51
30	9 07	9 07	9 08	9 08	9 09	9 10	9 11	9 12	9 13	9 14	9 15	9 16	9 18	9 20
31	10 05	10 07	10 09	10 11	10 14	10 16	10 19	10 22	10 25	10 29	10 33	10 38	10 44	10 50
Aug. 1	11 05	11 08	11 11	11 15	11 19	11 24	11 28	11 34	11 40	11 46	11 54	12 02	12 12	12 24
2	12 06	12 11	12 16	12 21	12 27	12 33	12 40	12 47	12 56	13 06	13 17	13 30	13 46	14 05
3	13 10	13 15	13 22	13 28	13 36	13 44	13 53	14 03	14 14	14 27	14 43	15 01	15 25	15 56
4	14 14	14 20	14 28	14 36	14 44	14 54	15 05	15 17	15 31	15 47	16 07	16 32	17 07	18 09
5	15 16	15 24	15 32	15 40	15 50	16 00	16 12	16 26	16 41	17 00	17 22	17 52	18 38	□
6	16 15	16 23	16 30	16 39	16 48	16 59	17 10	17 24	17 39	17 57	18 19	18 47	19 28	□
7	17 08	17 14	17 21	17 29	17 37	17 47	17 57	18 08	18 21	18 36	18 54	19 16	19 44	20 25
8	17 53	17 58	18 04	18 10	18 17	18 24	18 32	18 41	18 51	19 02	19 15	19 31	19 49	20 12
9	18 32	18 36	18 40	18 44	18 49	18 54	19 00	19 06	19 13	19 20	19 29	19 39	19 50	20 04
10	19 06	19 08	19 11	19 13	19 16	19 19	19 22	19 25	19 29	19 33	19 38	19 44	19 50	19 57
11	19 37	19 38	19 38	19 39	19 40	19 41	19 41	19 42	19 43	19 44	19 46	19 47	19 48	19 50
12	20 07	20 06	20 05	20 04	20 03	20 01	20 00	19 58	19 56	19 54	19 52	19 50	19 47	19 44
13	20 38	20 35	20 32	20 29	20 26	20 23	20 19	20 15	20 10	20 05	19 59	19 53	19 46	19 37
14	21 10	21 06	21 01	20 57	20 52	20 46	20 40	20 33	20 26	20 18	20 08	19 58	19 45	19 30
15	21 46	21 41	21 35	21 28	21 21	21 14	21 06	20 56	20 46	20 34	20 21	20 05	19 45	19 21
16	22 27	22 20	22 13	22 06	21 57	21 48	21 38	21 26	21 13	20 58	20 40	20 18	19 49	19 06
17	23 14	23 07	22 59	22 50	22 41	22 30	22 19	22 06	21 50	21 32	21 10	20 42	20 00	■

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55	-50°	-45	-40	-35°	-30°	-20°	-10°	0	+10°	+20°	+30°	+35°	+40
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	9 07	9 32	9 52	10 07	10 21	10 33	10 53	11 11	11 27	11 44	12 02	12 22	12 35	12 49
17	9 40	10 10	10 33	10 51	11 07	11 20	11 43	12 03	12 22	12 40	13 00	13 24	13 37	13 53
18	10 24	10 57	11 21	11 41	11 57	12 11	12 35	12 56	13 16	13 35	13 56	14 20	14 35	14 51
19	11 21	11 53	12 17	12 36	12 52	13 06	13 29	13 50	14 09	14 28	14 48	15 12	15 26	15 42
20	12 26	12 55	13 17	13 34	13 49	14 02	14 24	14 42	15 00	15 17	15 36	15 58	16 10	16 25
21	13 38	14 01	14 20	14 35	14 47	14 58	15 17	15 33	15 48	16 03	16 19	16 38	16 48	17 01
22	14 51	15 09	15 23	15 35	15 45	15 54	16 09	16 22	16 34	16 46	16 59	17 13	17 22	17 32
23	16 04	16 17	16 27	16 35	16 42	16 48	16 59	17 08	17 17	17 26	17 35	17 46	17 52	17 59
24	17 16	17 23	17 29	17 34	17 38	17 41	17 48	17 53	17 59	18 04	18 09	18 15	18 19	18 23
25	18 27	18 29	18 30	18 32	18 33	18 34	18 36	18 37	18 39	18 40	18 42	18 44	18 45	18 46
26	19 38	19 35	19 32	19 30	19 28	19 26	19 24	19 21	19 19	19 17	19 15	19 12	19 11	19 09
27	20 49	20 41	20 34	20 28	20 24	20 19	20 12	20 06	20 00	19 54	19 48	19 41	19 37	19 32
28	22 02	21 48	21 37	21 28	21 20	21 14	21 02	20 52	20 42	20 33	20 23	20 12	20 05	19 58
29	23 17	22 57	22 42	22 29	22 19	22 09	21 54	21 40	21 27	21 14	21 01	20 45	20 36	20 26
30	.. ..	.. ..	23 47	23 32	23 19	23 07	22 47	22 30	22 15	21 59	21 42	21 23	21 12	20 59
31	0 32	0 07	.. ..	.. ..	.. ..	.. ..	23 43	23 24	23 06	22 48	22 29	22 07	21 54	21 39
Sept. 1	1 45	1 15	0 53	0 34	0 19	0 06	.. ..	.. ..	.. ..	23 41	23 21	22 57	22 43	22 27
2	2 52	2 19	1 55	1 35	1 19	1 05	0 41	0 20	0 00	.. ..	.. ..	23 54	23 40	23 24
3	3 47	3 15	2 51	2 32	2 15	2 01	1 38	1 17	0 58	0 38	0 18	.. ..	.. ..	.. ..
4	4 29	4 01	3 40	3 22	3 05	2 55	2 33	2 14	1 56	1 38	1 19	0 57	0 44	0 29
5	5 00	4 38	4 20	4 06	3 54	3 44	3 25	3 09	2 54	2 39	2 23	2 05	1 54	1 42
6	5 23	5 07	4 55	4 45	4 36	4 28	4 15	4 03	3 52	3 40	3 28	3 15	3 07	2 57
7	5 41	5 32	5 25	5 19	5 13	5 09	5 01	4 54	4 47	4 40	4 33	4 25	4 20	4 15
8	5 57	5 54	5 52	5 50	5 49	5 47	5 45	5 43	5 41	5 39	5 37	5 35	5 33	5 32
9	6 12	6 16	6 19	6 21	6 23	6 25	6 28	6 31	6 34	6 37	6 40	6 44	6 46	6 48

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	1 10	0 46	0 28	0 13	0 00	.. ..	.. ..	.. ..	23 53	23 35	23 16	22 54	22 42	22 27
17	2 29	2 00	1 38	1 20	1 05	0 52	0 30	0 11	.. ..	.. ..	.. ..	23 44	23 30	23 14
18	3 38	3 05	2 41	2 22	2 05	1 51	1 28	1 07	0 48	0 28	0 08	.. ..	.. ..	.. ..
19	4 32	4 00	3 35	3 16	3 00	2 46	2 22	2 01	1 42	1 22	1 01	0 37	0 23	0 06
20	5 12	4 43	4 21	4 03	3 48	3 34	3 12	2 52	2 34	2 15	1 55	1 33	1 19	1 03
21	5 42	5 17	4 58	4 42	4 29	4 17	3 57	3 40	3 23	3 07	2 49	2 29	2 17	2 03
22	6 03	5 44	5 28	5 16	5 05	4 55	4 39	4 24	4 11	3 57	3 42	3 25	3 15	3 04
23	6 20	6 05	5 54	5 44	5 36	5 29	5 16	5 05	4 55	4 44	4 33	4 20	4 13	4 04
24	6 33	6 24	6 16	6 10	6 05	6 00	5 52	5 44	5 37	5 30	5 23	5 14	5 09	5 03
25	6 44	6 40	6 37	6 34	6 31	6 29	6 25	6 21	6 18	6 15	6 11	6 07	6 05	6 02
26	6 55	6 56	6 56	6 56	6 57	6 57	6 58	6 58	6 58	6 59	6 59	6 59	7 00	7 00
27	7 06	7 11	7 16	7 19	7 23	7 25	7 30	7 35	7 39	7 43	7 47	7 52	7 55	7 58
28	7 18	7 28	7 37	7 44	7 50	7 55	8 04	8 12	8 20	8 28	8 36	8 45	8 51	8 57
29	7 32	7 48	8 00	8 10	8 19	8 27	8 40	8 52	9 03	9 15	9 27	9 40	9 48	9 57
30	7 50	8 11	8 27	8 41	8 52	9 02	9 20	9 35	9 49	10 04	10 19	10 37	10 47	10 59
31	8 14	8 40	9 00	9 17	9 31	9 43	10 04	10 22	10 39	10 56	11 14	11 35	11 47	12 02
Sept. 1	8 47	9 18	9 42	10 00	10 16	10 30	10 53	11 13	11 32	11 50	12 11	12 34	12 48	13 03
2	9 35	10 08	10 33	10 52	11 09	11 23	11 47	12 08	12 28	12 47	13 08	13 32	13 46	14 02
3	10 39	11 11	11 35	11 54	12 10	12 23	12 47	13 07	13 26	13 44	14 04	14 27	14 40	14 56
4	11 59	12 26	12 46	13 03	13 17	13 29	13 50	14 07	14 24	14 41	14 58	15 18	15 30	15 43
5	13 28	13 48	14 04	14 17	14 28	14 38	14 54	15 09	15 22	15 35	15 49	16 05	16 14	16 24
6	15 01	15 15	15 25	15 34	15 41	15 48	15 59	16 09	16 18	16 27	16 36	16 47	16 53	17 00
7	16 36	16 42	16 47	16 51	16 55	16 58	17 03	17 08	17 13	17 17	17 22	17 27	17 30	17 33
8	18 09	18 09	18 09	18 08	18 08	18 08	18 07	18 07	18 06	18 06	18 05	18 05	18 04	18 04
9	19 43	19 35	19 30	19 25	19 20	19 17	19 10	19 05	19 00	18 54	18 49	18 42	18 39	18 35

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

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UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	12 49	12 55	13 02	13 09	13 17	13 26	13 36	13 47	14 00	14 15	14 32	14 54	15 23	16 05
17	13 53	14 00	14 08	14 16	14 26	14 36	14 47	15 00	15 15	15 33	15 55	16 23	17 05	■
18	14 51	14 59	15 07	15 15	15 25	15 36	15 48	16 01	16 17	16 36	17 00	17 30	18 19	■
19	15 42	15 49	15 57	16 05	16 14	16 24	16 36	16 49	17 04	17 21	17 43	18 10	18 50	■
20	16 25	16 31	16 38	16 45	16 54	17 03	17 13	17 24	17 37	17 52	18 09	18 31	18 59	19 39
21	17 01	17 06	17 12	17 18	17 25	17 33	17 41	17 50	18 00	18 12	18 25	18 41	19 01	19 25
22	17 32	17 36	17 40	17 45	17 51	17 56	18 03	18 10	18 17	18 26	18 36	18 47	19 01	19 17
23	17 59	18 02	18 05	18 08	18 12	18 16	18 20	18 25	18 31	18 37	18 43	18 51	19 00	19 10
24	18 23	18 25	18 27	18 29	18 31	18 33	18 36	18 39	18 42	18 45	18 49	18 53	18 58	19 04
25	18 46	18 47	18 47	18 48	18 48	18 49	18 50	18 51	18 52	18 53	18 54	18 55	18 56	18 58
26	19 09	19 08	19 07	19 06	19 06	19 05	19 04	19 02	19 01	19 00	18 58	18 57	18 55	18 52
27	19 32	19 30	19 28	19 26	19 23	19 21	19 18	19 15	19 11	19 08	19 03	18 58	18 53	18 47
28	19 58	19 54	19 51	19 47	19 43	19 39	19 34	19 29	19 23	19 17	19 10	19 01	18 52	18 41
29	20 26	20 22	20 17	20 12	20 06	20 00	19 53	19 46	19 38	19 29	19 18	19 06	18 52	18 34
30	20 59	20 54	20 48	20 41	20 34	20 26	20 18	20 08	19 57	19 45	19 31	19 14	18 53	18 27
Sept. 1	21 39	21 32	21 25	21 17	21 09	21 00	20 49	20 38	20 25	20 09	19 51	19 28	18 59	18 15
2	22 27	22 20	22 12	22 03	21 54	21 44	21 32	21 19	21 04	20 46	20 25	19 57	19 17	□
3	23 24	23 17	23 09	23 00	22 51	22 40	22 29	22 15	22 00	21 42	21 20	20 51	20 07	□
4	0 29	0 23	0 15	0 08	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 55	23 33	23 05
5	1 42	1 36	1 30	1 24	1 16	1 09	1 00	0 51	0 40	0 27	0 13	.. ..	.. ..	.. ..
6	2 57	2 53	2 49	2 44	2 39	2 34	2 27	2 21	2 13	2 05	1 55	1 43	1 30	1 13
7	4 15	4 12	4 10	4 07	4 04	4 01	3 57	3 53	3 49	3 44	3 39	3 32	3 25	3 17
8	5 32	5 31	5 30	5 30	5 29	5 28	5 27	5 26	5 25	5 23	5 22	5 20	5 18	5 16
9	6 48	6 50	6 51	6 52	6 53	6 55	6 56	6 58	7 00	7 02	7 04	7 07	7 10	7 14

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Aug. 16	22 27	22 20	22 13	22 06	21 57	21 48	21 38	21 26	21 13	20 58	20 40	20 18	19 49	19 06
17	23 14	23 07	22 59	22 50	22 41	22 30	22 19	22 06	21 50	21 32	21 10	20 42	20 00	■
18	.. ..	23 59	23 51	23 42	23 33	23 22	23 10	22 56	22 40	22 22	21 58	21 27	20 38	■
19	0 06	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 43	23 25	23 04	22 37	21 58	■
20	1 03	0 56	0 49	0 41	0 31	0 21	0 10	.. ..	.. ..	.. ..	.. ..	.. ..	23 33	22 54
21	2 03	1 57	1 50	1 43	1 35	1 26	1 17	1 06	0 53	0 39	0 22	0 01	.. ..	.. ..
22	3 04	2 59	2 53	2 47	2 41	2 34	2 26	2 17	2 08	1 57	1 44	1 28	1 10	0 46
23	4 04	4 00	3 56	3 52	3 47	3 42	3 36	3 30	3 23	3 15	3 05	2 55	2 42	2 27
24	5 03	5 01	4 58	4 55	4 52	4 49	4 45	4 41	4 36	4 31	4 25	4 19	4 11	4 02
25	6 02	6 01	5 59	5 58	5 56	5 55	5 53	5 51	5 49	5 47	5 44	5 41	5 37	5 33
26	7 00	7 00	7 00	7 00	7 00	7 01	7 01	7 01	7 01	7 01	7 01	7 02	7 02	7 02
27	7 58	8 00	8 01	8 03	8 04	8 06	8 08	8 11	8 13	8 16	8 19	8 23	8 27	8 32
28	8 57	9 00	9 03	9 06	9 09	9 13	9 17	9 22	9 27	9 32	9 39	9 46	9 54	10 04
29	9 57	10 02	10 06	10 11	10 16	10 21	10 27	10 34	10 42	10 50	11 00	11 11	11 25	11 41
30	10 59	11 05	11 10	11 16	11 23	11 30	11 39	11 48	11 58	12 10	12 23	12 40	13 00	13 25
Sept. 1	12 02	12 08	12 15	12 22	12 31	12 40	12 50	13 01	13 14	13 29	13 47	14 09	14 38	15 21
2	13 03	13 11	13 18	13 27	13 36	13 46	13 57	14 10	14 25	14 43	15 04	15 32	16 12	□
3	14 02	14 10	14 17	14 26	14 36	14 46	14 58	15 11	15 26	15 45	16 07	16 36	17 20	□
4	15 46	15 03	15 10	15 18	15 27	15 37	15 48	16 00	16 14	16 30	16 50	17 15	17 48	18 44
5	16 24	16 29	16 34	16 39	16 45	16 51	16 58	17 05	17 14	17 23	17 34	17 46	18 01	18 18
6	17 00	17 03	17 07	17 10	17 14	17 18	17 22	17 27	17 32	17 38	17 45	17 53	18 01	18 12
7	17 33	17 34	17 36	17 38	17 39	17 41	17 43	17 45	17 48	17 51	17 54	17 57	18 01	18 05
8	18 04	18 04	18 03	18 03	18 03	18 03	18 02	18 02	18 02	18 02	18 01	18 01	18 00	18 00
9	18 35	18 33	18 31	18 29	18 27	18 24	18 22	18 19	18 16	18 12	18 09	18 04	17 59	17 54

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	5 57	5 54	5 52	5 50	5 49	5 47	5 45	5 43	5 41	5 39	5 37	5 35	5 33	5 32
9	6 12	6 16	6 19	6 21	6 23	6 25	6 28	6 31	6 34	6 37	6 40	6 44	6 46	6 48
10	6 28	6 38	6 46	6 53	6 58	7 03	7 12	7 20	7 28	7 35	7 44	7 53	7 58	8 05
11	6 47	7 03	7 16	7 26	7 36	7 44	7 58	8 10	8 22	8 34	8 47	9 01	9 10	9 20
12	7 10	7 32	7 50	8 04	8 17	8 27	8 46	9 02	9 17	9 33	9 49	10 08	10 20	10 32
13	7 41	8 09	8 30	8 47	9 02	9 15	9 36	9 56	10 13	10 31	10 50	11 13	11 26	11 41
14	8 22	8 53	9 17	9 36	9 52	10 06	10 30	10 50	11 09	11 28	11 49	12 13	12 27	12 43
15	9 15	9 47	10 11	10 30	10 46	11 00	11 24	11 45	12 04	12 23	12 43	13 07	13 21	13 37
16	10 18	10 48	11 10	11 28	11 43	11 56	12 19	12 38	12 56	13 14	13 33	13 55	14 08	14 23
17	11 28	11 53	12 13	12 28	12 41	12 53	13 13	13 29	13 45	14 01	14 18	14 37	14 49	15 01
18	12 41	13 01	13 16	13 29	13 39	13 49	14 05	14 19	14 32	14 45	14 59	15 14	15 24	15 34
19	13 53	14 08	14 19	14 28	14 36	14 43	14 55	15 06	15 16	15 25	15 36	15 48	15 54	16 02
20	15 05	15 14	15 21	15 27	15 32	15 37	15 44	15 51	15 58	16 04	16 11	16 18	16 23	16 27
21	16 16	16 20	16 23	16 25	16 28	16 29	16 33	16 36	16 38	16 41	16 44	16 47	16 49	16 51
22	17 27	17 26	17 24	17 23	17 23	17 22	17 21	17 20	17 19	17 18	17 17	17 15	17 15	17 14
23	18 38	18 32	18 26	18 22	18 18	18 15	18 09	18 04	17 59	17 55	17 50	17 44	17 41	17 38
24	19 51	19 39	19 29	19 22	19 15	19 09	18 59	18 50	18 41	18 33	18 24	18 15	18 09	18 03
25	21 05	20 48	20 34	20 22	20 13	20 04	19 50	19 37	19 26	19 14	19 02	18 48	18 39	18 30
26	22 20	21 57	21 39	21 24	21 12	21 01	20 43	20 27	20 12	19 58	19 42	19 24	19 14	19 02
27	23 34	23 05	22 44	22 27	22 12	21 59	21 38	21 19	21 02	20 45	20 27	20 06	19 53	19 39
28	.. ..	.. ..	23 46	23 27	23 11	22 57	22 34	22 14	21 55	21 36	21 16	20 53	20 40	20 24
29	0 42	0 10	.. ..	.. ..	.. ..	23 54	23 30	23 09	22 50	22 31	22 10	21 47	21 33	21 17
30	1 39	1 07	0 43	0 24	0 08	.. ..	.. ..	.. ..	23 46	23 28	23 09	22 46	22 33	22 17
Oct. 1	2 25	1 55	1 33	1 15	1 00	0 47	0 24	0 05	.. ..	.. ..	.. ..	23 50	23 38	23 25
2	2 58	2 34	2 15	2 00	1 47	1 36	1 16	0 59	0 43	0 27	0 10	.. ..	.. ..	.. ..

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	18 09	18 09	18 09	18 08	18 08	18 08	18 07	18 07	18 06	18 06	18 05	18 05	18 04	18 04
9	19 43	19 35	19 30	19 25	19 20	19 17	19 10	19 05	19 00	18 54	18 49	18 42	18 39	18 35
10	21 15	21 01	20 50	20 40	20 32	20 26	20 14	20 03	19 53	19 44	19 33	19 22	19 15	19 07
11	22 45	22 24	22 08	21 55	21 43	21 33	21 17	21 02	20 48	20 35	20 20	20 04	19 54	19 43
12	.. ..	23 43	23 22	23 06	22 52	22 40	22 19	22 01	21 44	21 27	21 09	20 49	20 37	20 23
13	0 10	.. ..	.. ..	.. ..	23 56	23 42	23 19	22 59	22 40	22 21	22 01	21 38	21 25	21 09
14	1 25	0 54	0 30	0 11	.. ..	.. ..	.. ..	23 55	23 36	23 16	22 55	22 31	22 17	22 01
15	2 25	1 53	1 29	1 10	0 53	0 39	0 16	.. ..	.. ..	.. ..	23 50	23 27	23 13	22 58
16	3 11	2 41	2 18	2 00	1 44	1 31	1 08	0 48	0 29	0 10	.. ..	.. ..	.. ..	23 57
17	3 44	3 18	2 58	2 42	2 28	2 16	1 55	1 37	1 20	1 03	0 45	0 24	0 11	.. ..
18	4 08	3 47	3 31	3 17	3 06	2 55	2 38	2 23	2 08	1 54	1 38	1 20	1 09	0 57
19	4 26	4 11	3 58	3 47	3 38	3 31	3 17	3 05	2 53	2 42	2 29	2 15	2 07	1 58
20	4 41	4 30	4 21	4 14	4 08	4 02	3 53	3 44	3 36	3 28	3 19	3 09	3 03	2 57
21	4 53	4 47	4 42	4 38	4 35	4 32	4 27	4 22	4 17	4 13	4 08	4 02	3 59	3 55
22	5 04	5 03	5 02	5 02	5 01	5 00	4 59	4 59	4 58	4 57	4 56	4 55	4 54	4 53
23	5 15	5 19	5 22	5 25	5 27	5 29	5 32	5 35	5 38	5 41	5 44	5 47	5 49	5 52
24	5 27	5 36	5 43	5 49	5 54	5 58	6 06	6 13	6 19	6 26	6 33	6 41	6 45	6 51
25	5 41	5 55	6 06	6 15	6 23	6 30	6 42	6 52	7 02	7 12	7 23	7 35	7 43	7 51
26	5 58	6 17	6 32	6 44	6 55	7 04	7 20	7 34	7 48	8 01	8 15	8 32	8 41	8 52
27	6 20	6 44	7 03	7 19	7 32	7 43	8 03	8 20	8 36	8 52	9 09	9 29	9 41	9 54
28	6 50	7 19	7 41	7 59	8 14	8 27	8 50	9 09	9 27	9 45	10 05	10 27	10 40	10 56
29	7 32	8 05	8 29	8 48	9 04	9 18	9 42	10 02	10 21	10 40	11 01	11 24	11 38	11 54
30	8 29	9 01	9 25	9 44	10 00	10 14	10 38	10 58	11 17	11 36	11 56	12 19	12 33	12 48
Oct. 1	9 41	10 09	10 31	10 49	11 03	11 16	11 37	11 56	12 13	12 31	12 49	13 10	13 22	13 37
2	11 03	11 26	11 44	11 58	12 10	12 21	12 39	12 55	13 09	13 24	13 39	13 57	14 07	14 19

.. indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	5 32	5 31	5 30	5 30	5 29	5 28	5 27	5 26	5 25	5 23	5 22	5 20	5 18	5 16
9	6 48	6 50	6 51	6 52	6 53	6 55	6 56	6 58	7 00	7 02	7 04	7 07	7 10	7 14
10	8 05	8 07	8 10	8 13	8 17	8 21	8 25	8 29	8 34	8 40	8 46	8 54	9 02	9 12
11	9 20	9 24	9 29	9 34	9 39	9 45	9 52	9 59	10 07	10 17	10 28	10 40	10 55	11 13
12	10 32	10 38	10 44	10 51	10 59	11 07	11 16	11 26	11 37	11 50	12 06	12 24	12 48	13 20
13	11 41	11 48	11 55	12 03	12 12	12 22	12 32	12 45	12 59	13 15	13 35	14 01	14 36	15 42
14	12 43	12 50	12 58	13 07	13 16	13 27	13 39	13 52	14 08	14 26	14 49	15 18	16 04	■
15	13 37	13 44	13 52	14 01	14 10	14 20	14 32	14 45	15 00	15 18	15 40	16 08	16 50	■
16	14 23	14 30	14 37	14 45	14 53	15 02	15 13	15 25	15 38	15 54	16 12	16 35	17 06	17 52
17	15 01	15 07	15 13	15 20	15 27	15 35	15 44	15 54	16 05	16 17	16 32	16 49	17 11	17 38
18	15 34	15 39	15 44	15 49	15 55	16 01	16 08	16 15	16 24	16 33	16 44	16 57	17 12	17 30
19	16 02	16 06	16 09	16 13	16 17	16 22	16 27	16 32	16 38	16 45	16 53	17 02	17 12	17 23
20	16 27	16 30	16 32	16 34	16 37	16 40	16 43	16 47	16 50	16 55	16 59	17 05	17 11	17 18
21	16 51	16 52	16 53	16 54	16 55	16 56	16 58	16 59	17 01	17 03	17 05	17 07	17 09	17 12
22	17 14	17 14	17 13	17 13	17 13	17 12	17 12	17 11	17 11	17 10	17 10	17 09	17 08	17 07
23	17 38	17 36	17 34	17 33	17 31	17 29	17 26	17 24	17 21	17 18	17 15	17 11	17 07	17 02
24	18 03	18 00	17 57	17 53	17 50	17 46	17 42	17 38	17 33	17 27	17 21	17 14	17 06	16 57
25	18 30	18 26	18 22	18 17	18 12	18 07	18 01	17 54	17 47	17 38	17 29	17 18	17 06	16 51
26	19 02	18 57	18 51	18 45	18 38	18 31	18 23	18 15	18 05	17 54	17 41	17 26	17 08	16 45
27	19 39	19 33	19 26	19 19	19 11	19 02	18 53	18 42	18 30	18 15	17 59	17 39	17 13	16 37
28	20 24	20 17	20 10	20 01	19 52	19 42	19 31	19 19	19 05	18 48	18 28	18 02	17 27	16 21
29	21 17	21 10	21 02	20 53	20 44	20 34	20 22	20 09	19 54	19 36	19 14	18 46	18 04	□
30	22 17	22 11	22 03	21 55	21 46	21 36	21 25	21 13	20 59	20 42	20 22	19 56	19 21	18 12
Oct. 1	23 25	23 19	23 12	23 05	22 58	22 49	22 40	22 29	22 18	22 04	21 48	21 28	21 03	20 28
2	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 54	23 45	23 35	23 23	23 09	22 53	22 33

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Sept. 8	18 04	18 04	18 03	18 03	18 03	18 03	18 02	18 02	18 02	18 02	18 01	18 01	18 00	18 00
9	18 35	18 33	18 31	18 29	18 27	18 24	18 22	18 19	18 16	18 12	18 09	18 04	17 59	17 54
10	19 07	19 04	19 00	18 56	18 52	18 48	18 43	18 37	18 31	18 25	18 17	18 09	17 59	17 47
11	19 43	19 38	19 33	19 27	19 21	19 15	19 07	18 59	18 50	18 40	18 29	18 15	17 59	17 40
12	20 23	20 17	20 11	20 04	19 56	19 47	19 38	19 27	19 15	19 02	18 46	18 26	18 02	17 30
13	21 09	21 02	20 55	20 47	20 38	20 28	20 17	20 04	19 50	19 33	19 13	18 47	18 12	17 05
14	22 01	21 54	21 46	21 37	21 28	21 17	21 05	20 52	20 36	20 18	19 55	19 25	18 40	■
15	22 58	22 50	22 43	22 34	22 25	22 15	22 03	21 50	21 35	21 18	20 56	20 28	19 46	■
16	23 57	23 50	23 44	23 36	23 28	23 19	23 09	22 57	22 44	22 29	22 11	21 48	21 18	20 32
17	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 45	23 31	23 14	22 54	22 27
18	0 57	0 52	0 46	0 40	0 33	0 25	0 17	0 08	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
19	1 58	1 53	1 49	1 44	1 39	1 33	1 27	1 20	1 12	1 03	0 53	0 41	0 27	0 09
20	2 57	2 54	2 51	2 47	2 44	2 40	2 35	2 31	2 25	2 19	2 13	2 05	1 56	1 45
21	3 55	3 54	3 52	3 50	3 48	3 46	3 44	3 41	3 38	3 35	3 31	3 27	3 22	3 17
22	4 53	4 53	4 53	4 52	4 52	4 52	4 51	4 51	4 50	4 49	4 49	4 48	4 47	4 46
23	5 52	5 53	5 54	5 55	5 56	5 57	5 59	6 00	6 02	6 04	6 06	6 09	6 12	6 15
24	6 51	6 53	6 55	6 58	7 01	7 04	7 07	7 11	7 15	7 20	7 25	7 31	7 38	7 46
25	7 51	7 54	7 58	8 02	8 07	8 12	8 17	8 23	8 30	8 37	8 46	8 56	9 07	9 21
26	8 52	8 57	9 02	9 08	9 14	9 21	9 28	9 36	9 46	9 56	10 08	10 23	10 40	11 02
27	9 54	10 00	10 07	10 14	10 21	10 30	10 39	10 50	11 01	11 15	11 31	11 51	12 16	12 51
28	10 56	11 02	11 10	11 18	11 27	11 36	11 47	11 59	12 14	12 30	12 50	13 15	13 50	14 56
29	11 54	12 02	12 09	12 18	12 27	12 38	12 49	13 02	13 17	13 35	13 57	14 25	15 07	□
30	12 48	12 56	13 03	13 11	13 20	13 30	13 41	13 54	14 08	14 25	14 46	15 12	15 47	16 57
Oct. 1	13 37	13 43	13 50	13 57	14 05	14 14	14 23	14 34	14 47	15 01	15 17	15 38	16 03	16 39
2	14 19	14 24	14 29	14 35	14 42	14 49	14 56	15 05	15 14	15 25	15 37	15 52	16 09	16 31

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

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MOONRISE AND MOONSET, 2010

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	2 25	1 55	1 33	1 15	1 00	0 47	0 24	0 05	...	...	...	23 50	23 38	23 25
2	2 58	2 34	2 15	2 00	1 47	1 36	1 16	0 59	0 43	0 27	0 10	...	...	...
3	3 24	3 06	2 51	2 39	2 29	2 20	2 05	1 51	1 38	1 25	1 12	0 56	0 47	0 36
4	3 43	3 32	3 22	3 14	3 07	3 01	2 50	2 41	2 32	2 24	2 14	2 03	1 57	1 50
5	4 00	3 54	3 50	3 46	3 43	3 40	3 34	3 30	3 26	3 21	3 17	3 11	3 08	3 05
6	4 16	4 16	4 16	4 17	4 17	4 17	4 17	4 18	4 18	4 19	4 19	4 20	4 20	4 20
7	4 31	4 38	4 43	4 48	4 51	4 55	5 01	5 06	5 11	5 16	5 22	5 28	5 32	5 36
8	4 49	5 02	5 12	5 21	5 28	5 35	5 46	5 56	6 06	6 15	6 26	6 37	6 44	6 52
9	5 11	5 30	5 45	5 57	6 08	6 17	6 34	6 48	7 01	7 15	7 30	7 47	7 56	8 08
10	5 39	6 04	6 23	6 39	6 52	7 04	7 24	7 42	7 59	8 15	8 33	8 54	9 06	9 20
11	6 16	6 46	7 09	7 27	7 42	7 55	8 18	8 38	8 57	9 15	9 35	9 58	10 12	10 28
12	7 06	7 38	8 01	8 20	8 36	8 50	9 14	9 34	9 53	10 13	10 33	10 57	11 11	11 27
13	8 07	8 37	9 00	9 19	9 34	9 47	10 10	10 30	10 48	11 06	11 26	11 49	12 02	12 17
14	9 16	9 43	10 03	10 19	10 33	10 45	11 05	11 23	11 40	11 56	12 14	12 34	12 46	12 59
15	10 29	10 50	11 07	11 20	11 32	11 42	11 59	12 14	12 28	12 42	12 56	13 13	13 23	13 34
16	11 42	11 58	12 10	12 20	12 29	12 37	12 50	13 02	13 13	13 23	13 35	13 48	13 55	14 04
17	12 54	13 04	13 13	13 20	13 26	13 31	13 40	13 48	13 55	14 03	14 11	14 19	14 25	14 30
18	14 05	14 10	14 14	14 18	14 21	14 24	14 28	14 32	14 36	14 40	14 44	14 49	14 52	14 55
19	15 15	15 15	15 16	15 16	15 16	15 16	15 16	15 17	15 17	15 17	15 17	15 18	15 18	15 18
20	16 26	16 21	16 17	16 14	16 11	16 09	16 05	16 01	15 57	15 54	15 50	15 46	15 44	15 41
21	17 38	17 28	17 20	17 13	17 08	17 03	16 54	16 46	16 39	16 32	16 25	16 16	16 12	16 06
22	18 52	18 37	18 24	18 14	18 06	17 58	17 45	17 34	17 23	17 13	17 01	16 49	16 41	16 33
23	20 08	19 47	19 30	19 16	19 05	18 55	18 38	18 23	18 09	17 56	17 41	17 25	17 15	17 04
24	21 22	20 56	20 36	20 19	20 05	19 53	19 33	19 15	18 59	18 43	18 25	18 05	17 54	17 40
25	22 33	22 02	21 39	21 21	21 05	20 52	20 29	20 10	19 51	19 33	19 14	18 51	18 38	18 23

MOONSET														
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	9 41	10 09	10 31	10 49	11 03	11 16	11 37	11 56	12 13	12 31	12 49	13 10	13 22	13 37
2	11 03	11 26	11 44	11 58	12 10	12 21	12 39	12 55	13 09	13 24	13 39	13 57	14 07	14 19
3	12 31	12 48	13 01	13 11	13 20	13 28	13 42	13 53	14 04	14 15	14 26	14 39	14 47	14 55
4	14 02	14 11	14 19	14 26	14 31	14 36	14 44	14 51	14 58	15 04	15 11	15 19	15 23	15 28
5	15 33	15 36	15 39	15 41	15 42	15 44	15 46	15 48	15 50	15 52	15 54	15 57	15 58	16 00
6	17 06	17 02	16 59	16 56	16 54	16 52	16 49	16 46	16 43	16 40	16 38	16 34	16 32	16 30
7	18 38	18 28	18 19	18 12	18 06	18 01	17 52	17 44	17 37	17 29	17 22	17 13	17 08	17 02
8	20 11	19 53	19 40	19 28	19 19	19 10	18 56	18 44	18 32	18 20	18 08	17 54	17 46	17 36
9	21 40	21 16	20 58	20 43	20 30	20 19	20 00	19 44	19 29	19 13	18 57	18 39	18 28	18 16
10	23 02	22 33	22 11	21 53	21 38	21 25	21 03	20 44	20 26	20 09	19 50	19 28	19 15	19 00
11	...	23 39	23 16	22 57	22 41	22 27	22 03	21 43	21 24	21 05	20 45	20 21	20 07	19 51
12	0 11	...	...	23 52	23 36	23 22	22 59	22 39	22 20	22 01	21 41	21 17	21 03	20 47
13	1 04	0 33	0 10	...	...	...	23 49	23 31	23 13	22 56	22 37	22 15	22 02	21 47
14	1 43	1 16	0 55	0 38	0 23	0 11	...	...	...	23 48	23 31	23 12	23 01	22 48
15	2 11	1 48	1 31	1 16	1 04	0 53	0 35	0 18	0 03	...	...	...	...	23 49
16	2 31	2 14	2 00	1 49	1 39	1 30	1 15	1 02	0 50	0 37	0 24	0 09	0 00	...
17	2 47	2 35	2 25	2 17	2 09	2 03	1 52	1 43	1 33	1 24	1 14	1 03	0 57	0 49
18	3 00	2 53	2 47	2 42	2 37	2 34	2 27	2 21	2 15	2 10	2 03	1 56	1 52	1 48
19	3 12	3 09	3 07	3 05	3 04	3 02	3 00	2 58	2 56	2 54	2 52	2 49	2 47	2 46
20	3 23	3 25	3 27	3 29	3 30	3 31	3 33	3 35	3 36	3 38	3 40	3 41	3 43	3 44
21	3 35	3 42	3 48	3 53	3 57	4 00	4 07	4 12	4 17	4 23	4 28	4 35	4 38	4 43
22	3 49	4 01	4 10	4 18	4 25	4 31	4 42	4 51	5 00	5 09	5 18	5 29	5 35	5 43
23	4 05	4 22	4 36	4 47	4 57	5 05	5 20	5 33	5 45	5 57	6 10	6 25	6 34	6 44
24	4 26	4 48	5 06	5 20	5 32	5 43	6 02	6 18	6 33	6 48	7 04	7 23	7 34	7 47
25	4 54	5 21	5 42	5 59	6 14	6 26	6 48	7 06	7 24	7 41	8 00	8 22	8 34	8 49

... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

57

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 1	23 25	23 19	23 12	23 05	22 58	22 49	22 40	22 29	22 18	22 04	21 48	21 28	21 03	20 28
2	...	...	...	...	...	...	...	23 54	23 45	23 35	23 23	23 09	22 53	22 33
3	0 36	0 32	0 26	0 21	0 15	0 09	0 02	...	...	...	...	...	...	...
4	1 50	1 47	1 44	1 40	1 36	1 32	1 27	1 22	1 16	1 10	1 02	0 54	0 44	0 32
5	3 05	3 03	3 02	3 00	2 58	2 56	2 54	2 51	2 49	2 46	2 42	2 39	2 34	2 29
6	4 20	4 20	4 21	4 21	4 21	4 21	4 22	4 22	4 22	4 22	4 23	4 23	4 24	4 24
7	5 36	5 38	5 40	5 42	5 45	5 47	5 50	5 53	5 56	6 00	6 04	6 09	6 15	6 21
8	6 52	6 56	7 00	7 04	7 08	7 13	7 18	7 24	7 31	7 38	7 46	7 56	8 07	8 21
9	8 08	8 13	8 18	8 24	8 31	8 38	8 45	8 54	9 04	9 15	9 28	9 43	10 02	10 25
10	9 20	9 27	9 34	9 41	9 49	9 58	10 08	10 19	10 32	10 47	11 04	11 26	11 54	12 37
11	10 28	10 35	10 42	10 51	11 00	11 10	11 21	11 34	11 49	12 06	12 28	12 55	13 35	■
12	11 27	11 34	11 42	11 50	12 00	12 10	12 22	12 35	12 50	13 08	13 30	13 59	14 41	■
13	12 17	12 24	12 31	12 39	12 48	12 58	13 09	13 21	13 35	13 51	14 10	14 35	15 08	16 04
14	12 59	13 05	13 12	13 19	13 26	13 35	13 44	13 54	14 06	14 19	14 35	14 54	15 18	15 49
15	13 34	13 39	13 44	13 50	13 56	14 03	14 10	14 19	14 28	14 38	14 50	15 04	15 21	15 41
16	14 04	14 08	14 12	14 16	14 21	14 26	14 32	14 38	14 44	14 52	15 01	15 10	15 22	15 35
17	14 30	14 33	14 36	14 39	14 42	14 45	14 49	14 53	14 57	15 02	15 08	15 14	15 22	15 30
18	14 55	14 56	14 57	14 59	15 01	15 02	15 04	15 06	15 09	15 11	15 14	15 17	15 21	15 25
19	15 18	15 18	15 18	15 18	15 18	15 19	15 19	15 19	15 19	15 19	15 19	15 20	15 20	15 20
20	15 41	15 40	15 39	15 38	15 36	15 35	15 33	15 31	15 29	15 27	15 25	15 22	15 19	15 15
21	16 06	16 04	16 01	15 58	15 55	15 52	15 49	15 45	15 41	15 36	15 31	15 25	15 19	15 11
22	16 33	16 30	16 26	16 21	16 17	16 12	16 07	16 01	15 54	15 47	15 39	15 30	15 19	15 06
23	17 04	16 59	16 54	16 48	16 42	16 36	16 29	16 21	16 12	16 02	15 50	15 37	15 21	15 01
24	17 40	17 34	17 28	17 21	17 14	17 05	16 56	16 46	16 35	16 22	16 06	15 48	15 25	14 55
25	18 23	18 16	18 09	18 01	17 53	17 43	17 33	17 21	17 07	16 51	16 32	16 09	15 37	14 48

MOONSET

Oct.	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	13 37	13 43	13 50	13 57	14 05	14 14	14 23	14 34	14 47	15 01	15 17	15 38	16 03	16 39
2	14 19	14 24	14 29	14 35	14 42	14 49	14 56	15 05	15 14	15 25	15 37	15 52	16 09	16 31
3	14 55	14 59	15 03	15 07	15 12	15 17	15 22	15 28	15 35	15 42	15 51	16 00	16 11	16 25
4	15 28	15 31	15 33	15 36	15 38	15 41	15 44	15 48	15 52	15 56	16 01	16 06	16 12	16 19
5	16 00	16 00	16 01	16 02	16 02	16 03	16 04	16 05	16 06	16 07	16 09	16 10	16 12	16 14
6	16 30	16 29	16 28	16 27	16 26	16 25	16 23	16 22	16 20	16 18	16 16	16 14	16 11	16 08
7	17 02	16 59	16 57	16 54	16 51	16 47	16 44	16 40	16 35	16 30	16 25	16 18	16 11	16 03
8	17 36	17 32	17 28	17 23	17 18	17 13	17 07	17 00	16 53	16 45	16 35	16 25	16 12	15 57
9	18 16	18 10	18 04	17 58	17 51	17 43	17 35	17 26	17 16	17 04	16 50	16 34	16 15	15 50
10	19 00	18 54	18 47	18 39	18 31	18 21	18 11	18 00	17 46	17 31	17 13	16 51	16 22	15 39
11	19 51	19 44	19 36	19 28	19 19	19 08	18 57	18 44	18 29	18 11	17 50	17 22	16 42	■
12	20 47	20 40	20 33	20 24	20 15	20 04	19 53	19 40	19 25	19 07	18 45	18 16	17 34	■
13	21 47	21 41	21 33	21 26	21 17	21 08	20 57	20 45	20 32	20 16	19 56	19 32	19 00	18 04
14	22 48	22 43	22 37	22 30	22 23	22 15	22 06	21 56	21 45	21 32	21 16	20 58	20 35	20 04
15	23 49	23 45	23 40	23 35	23 29	23 22	23 16	23 08	22 59	22 49	22 38	22 25	22 09	21 49
16	...	...	...	...	...	...	...	...	...	...	23 59	23 50	23 39	23 27
17	0 49	0 46	0 42	0 38	0 34	0 30	0 25	0 19	0 13	0 06	...	...	...	...
18	1 48	1 46	1 44	1 41	1 39	1 36	1 33	1 30	1 26	1 22	1 17	1 12	1 06	0 59
19	2 46	2 45	2 44	2 43	2 42	2 41	2 40	2 39	2 38	2 36	2 35	2 33	2 31	2 28
20	3 44	3 44	3 45	3 46	3 46	3 47	3 48	3 49	3 50	3 51	3 52	3 53	3 55	3 57
21	4 43	4 44	4 46	4 49	4 51	4 53	4 56	4 59	5 02	5 06	5 10	5 15	5 20	5 27
22	5 43	5 46	5 49	5 53	5 57	6 01	6 06	6 11	6 17	6 23	6 30	6 39	6 49	7 00
23	6 44	6 48	6 53	6 58	7 04	7 10	7 17	7 24	7 33	7 42	7 53	8 06	8 21	8 39
24	7 47	7 52	7 58	8 05	8 12	8 20	8 28	8 38	8 49	9 02	9 17	9 34	9 56	10 26
25	8 49	8 55	9 03	9 10	9 19	9 28	9 38	9 50	10 03	10 19	10 37	11 01	11 32	12 21

■ indicates Moon continuously below horizon.
 ... indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010
UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	21 22	20 56	20 36	20 19	20 05	19 53	19 33	19 15	18 59	18 43	18 25	18 05	17 54	17 40
	25	22 33	22 02	21 39	21 21	21 05	20 52	20 29	20 10	19 51	19 33	19 14	18 51	18 38
	26	23 34	23 02	22 38	22 19	22 03	21 49	21 25	21 05	20 46	20 27	20 07	19 43	19 30
	27	.. ..	23 53	23 30	23 12	22 56	22 43	22 20	22 00	21 42	21 23	21 04	20 41	20 27
	28	0 23	.. ..	.. ..	23 58	23 44	23 32	23 12	22 54	22 38	22 21	22 03	21 42	21 30
Nov. 29	0 59	0 34	0 14	.. ..	.. ..	.. ..	.. ..	23 46	23 32	23 18	23 03	22 46	22 37	22 25
	30	1 26	1 06	0 51	0 38	0 27	0 17	0 00	.. ..	.. ..	.. ..	23 51	23 44	23 36
	31	1 47	1 33	1 22	1 13	1 05	0 58	0 46	0 35	0 25	0 15	0 04	.. ..	.. ..
	1	2 04	1 57	1 50	1 45	1 40	1 36	1 29	1 22	1 16	1 10	1 04	0 57	0 52
	2	2 20	2 18	2 16	2 15	2 13	2 12	2 10	2 09	2 07	2 06	2 04	2 02	2 01
Nov. 3	2 35	2 39	2 42	2 44	2 47	2 49	2 52	2 55	2 58	3 01	3 04	3 08	3 10	3 13
	4	2 51	3 01	3 09	3 16	3 21	3 26	3 35	3 43	3 50	3 58	4 06	4 15	4 21
	5	3 11	3 27	3 39	3 50	3 59	4 07	4 21	4 33	4 45	4 56	5 09	5 23	5 32
	6	3 36	3 58	4 15	4 29	4 41	4 52	5 10	5 26	5 41	5 56	6 13	6 32	6 43
	7	4 09	4 36	4 57	5 14	5 29	5 41	6 03	6 22	6 39	6 57	7 16	7 38	7 51
Nov. 8	4 53	5 24	5 47	6 06	6 22	6 35	6 59	7 19	7 38	7 57	8 17	8 40	8 54	9 10
	9	5 51	6 22	6 45	7 04	7 19	7 33	7 56	8 16	8 35	8 54	9 14	9 37	9 50
	10	6 59	7 27	7 48	8 05	8 19	8 32	8 53	9 12	9 29	9 46	10 05	10 26	10 38
	11	8 12	8 35	8 53	9 07	9 20	9 30	9 49	10 05	10 20	10 35	10 50	11 09	11 19
	12	9 26	9 44	9 58	10 09	10 19	10 27	10 42	10 55	11 07	11 19	11 31	11 46	11 54
Nov. 13	10 39	10 51	11 01	11 09	11 16	11 22	11 33	11 42	11 51	11 59	12 08	12 19	12 25	12 32
	14	11 50	11 57	12 03	12 08	12 12	12 16	12 22	12 27	12 33	12 38	12 43	12 49	12 53
	15	13 01	13 03	13 04	13 06	13 07	13 08	13 10	13 12	13 13	13 15	13 16	13 18	13 19
	16	14 11	14 08	14 06	14 04	14 02	14 01	13 58	13 56	13 54	13 51	13 49	13 47	13 45
	17	15 23	15 14	15 08	15 02	14 58	14 54	14 47	14 40	14 35	14 29	14 23	14 16	14 12

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	4 26	4 48	5 06	5 20	5 32	5 43	6 02	6 18	6 33	6 48	7 04	7 23	7 34	7 47
	25	4 54	5 21	5 42	5 59	6 14	6 26	6 48	7 06	7 24	7 41	8 00	8 22	8 49
	26	5 33	6 04	6 27	6 46	7 02	7 15	7 39	7 59	8 17	8 36	8 56	9 20	9 49
	27	6 26	6 57	7 21	7 40	7 56	8 10	8 34	8 54	9 13	9 32	9 52	10 15	10 44
	28	7 32	8 02	8 24	8 42	8 57	9 10	9 32	9 51	10 09	10 26	10 45	11 07	11 34
Nov. 29	8 50	9 15	9 34	9 49	10 02	10 13	10 32	10 48	11 04	11 19	11 35	11 54	12 05	12 17
	30	10 14	10 33	10 47	10 59	11 09	11 17	11 32	11 45	11 57	12 09	12 22	12 37	12 54
	31	11 41	11 53	12 02	12 10	12 17	12 23	12 33	12 41	12 49	12 58	13 06	13 16	13 27
	1	13 08	13 14	13 18	13 22	13 25	13 28	13 33	13 37	13 40	13 44	13 48	13 53	13 58
	2	14 37	14 36	14 35	14 34	14 34	14 34	14 33	14 32	14 31	14 31	14 30	14 29	14 28
Nov. 3	16 06	15 59	15 53	15 48	15 44	15 40	15 34	15 28	15 23	15 18	15 12	15 06	15 02	14 58
	4	17 36	17 22	17 11	17 02	16 54	16 48	16 36	16 26	16 16	16 06	15 56	15 45	15 30
	5	19 06	18 46	18 30	18 17	18 06	17 56	17 39	17 25	17 11	16 58	16 44	16 27	16 07
	6	20 33	20 06	19 46	19 29	19 16	19 04	18 43	18 25	18 09	17 52	17 35	17 14	16 49
	7	21 49	21 19	20 56	20 37	20 22	20 08	19 46	19 26	19 07	18 49	18 29	18 06	17 38
Nov. 8	22 51	22 20	21 56	21 37	21 22	21 08	20 45	20 24	20 05	19 46	19 26	19 02	18 49	18 33
	9	23 37	23 08	22 46	22 29	22 14	22 01	21 39	21 19	21 01	20 43	20 24	20 01	19 48
	10	.. ..	23 46	23 27	23 11	22 58	22 47	22 27	22 10	21 54	21 38	21 20	21 00	20 35
	11	0 10	.. ..	23 59	23 47	23 36	23 27	23 10	22 56	22 43	22 29	22 15	21 58	21 37
	12	0 34	0 14	.. ..	.. ..	.. ..	.. ..	23 49	23 39	23 28	23 18	23 07	22 54	22 38
Nov. 13	0 52	0 38	0 26	0 17	0 09	0 02	.. ..	.. ..	.. ..	.. ..	23 57	23 48	23 43	23 38
	14	1 06	0 57	0 50	0 43	0 38	0 33	0 25	0 18	0 11	0 04	.. ..	.. ..	.. ..
	15	1 18	1 14	1 11	1 08	1 05	1 03	0 59	0 55	0 52	0 49	0 45	0 41	0 39
	16	1 30	1 30	1 31	1 31	1 31	1 32	1 32	1 32	1 33	1 33	1 33	1 34	1 34
	17	1 42	1 47	1 51	1 55	1 58	2 00	2 05	2 09	2 13	2 17	2 21	2 26	2 32

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

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UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	17 40	17 34	17 28	17 21	17 14	17 05	16 56	16 46	16 35	16 22	16 06	15 48	15 25	14 55
25	18 23	18 16	18 09	18 01	17 53	17 43	17 33	17 21	17 07	16 51	16 32	16 09	15 37	14 48
26	19 14	19 07	18 59	18 51	18 41	18 31	18 20	18 07	17 52	17 35	17 14	16 46	16 08	□
27	20 12	20 05	19 57	19 49	19 40	19 30	19 19	19 07	18 53	18 36	18 15	17 49	17 12	15 55
28	21 17	21 10	21 04	20 56	20 48	20 40	20 30	20 19	20 06	19 52	19 35	19 14	18 47	18 07
29	22 25	22 20	22 15	22 09	22 02	21 55	21 48	21 39	21 29	21 18	21 05	20 50	20 32	20 08
30	23 36	23 32	23 28	23 24	23 20	23 15	23 09	23 03	22 56	22 49	22 40	22 30	22 18	22 04
31	...	...	...	...	...	...	...	...	...	...	...	...	...	23 57
Nov. 1	0 48	0 46	0 43	0 41	0 38	0 35	0 32	0 29	0 25	0 21	0 16	0 11	0 04	...
2	2 00	1 59	1 59	1 58	1 58	1 57	1 56	1 55	1 54	1 53	1 52	1 51	1 49	1 48
3	3 13	3 14	3 15	3 16	3 18	3 19	3 21	3 23	3 25	3 27	3 29	3 32	3 35	3 39
4	4 27	4 30	4 32	4 36	4 39	4 43	4 47	4 51	4 56	5 02	5 08	5 15	5 24	5 34
5	5 41	5 46	5 50	5 55	6 01	6 07	6 13	6 20	6 28	6 38	6 48	7 00	7 15	7 33
6	6 55	7 01	7 07	7 14	7 21	7 29	7 38	7 48	7 59	8 12	8 27	8 45	9 08	9 39
7	8 06	8 13	8 20	8 28	8 37	8 46	8 57	9 09	9 23	9 39	9 58	10 23	10 56	11 54
8	9 10	9 17	9 25	9 34	9 43	9 53	10 05	10 18	10 33	10 51	11 12	11 40	12 22	■
9	10 06	10 13	10 20	10 29	10 38	10 48	10 59	11 11	11 26	11 43	12 03	12 30	13 06	14 20
10	10 52	10 59	11 06	11 13	11 21	11 30	11 40	11 51	12 03	12 18	12 35	12 56	13 23	14 00
11	11 31	11 36	11 42	11 48	11 55	12 03	12 11	12 20	12 30	12 41	12 54	13 10	13 29	13 53
12	12 04	12 08	12 12	12 17	12 22	12 28	12 34	12 41	12 49	12 57	13 07	13 18	13 31	13 47
13	12 32	12 35	12 38	12 41	12 45	12 49	12 53	12 58	13 03	13 09	13 16	13 23	13 32	13 42
14	12 57	12 59	13 00	13 02	13 05	13 07	13 09	13 12	13 15	13 19	13 22	13 27	13 31	13 37
15	13 20	13 21	13 21	13 22	13 23	13 23	13 24	13 25	13 26	13 27	13 28	13 29	13 31	13 33
16	13 44	13 43	13 42	13 41	13 41	13 40	13 39	13 38	13 36	13 35	13 34	13 32	13 30	13 28
17	14 08	14 06	14 04	14 02	13 59	13 57	13 54	13 51	13 48	13 44	13 40	13 35	13 30	13 24

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Oct. 24	7 47	7 52	7 58	8 05	8 12	8 20	8 28	8 38	8 49	9 02	9 17	9 34	9 56	10 26
25	8 49	8 55	9 03	9 10	9 19	9 28	9 38	9 50	10 03	10 19	10 37	11 01	11 32	12 21
26	9 49	9 56	10 04	10 12	10 21	10 31	10 42	10 55	11 10	11 27	11 48	12 16	12 54	□
27	10 44	10 52	10 59	11 07	11 16	11 26	11 38	11 50	12 05	12 22	12 43	13 09	13 46	15 03
28	11 34	11 40	11 47	11 55	12 03	12 12	12 22	12 33	12 46	13 01	13 19	13 40	14 08	14 48
29	12 17	12 22	12 28	12 35	12 41	12 49	12 57	13 06	13 17	13 28	13 42	13 58	14 17	14 41
30	12 54	12 58	13 03	13 08	13 13	13 18	13 25	13 31	13 39	13 47	13 57	14 08	14 21	14 36
31	13 27	13 30	13 33	13 36	13 40	13 43	13 47	13 52	13 56	14 02	14 08	14 14	14 22	14 31
Nov. 1	13 58	13 59	14 01	14 02	14 04	14 05	14 07	14 09	14 11	14 14	14 16	14 19	14 22	14 26
2	14 28	14 27	14 27	14 27	14 27	14 26	14 26	14 25	14 25	14 24	14 24	14 23	14 22	14 22
3	14 58	14 56	14 54	14 52	14 50	14 48	14 45	14 42	14 39	14 36	14 32	14 27	14 22	14 17
4	15 30	15 27	15 24	15 20	15 16	15 11	15 06	15 01	14 55	14 49	14 41	14 33	14 23	14 12
5	16 07	16 02	15 57	15 52	15 46	15 39	15 32	15 24	15 15	15 05	14 54	14 41	14 25	14 06
6	16 49	16 43	16 36	16 29	16 22	16 13	16 04	15 54	15 42	15 29	15 13	14 54	14 30	13 59
7	17 38	17 31	17 23	17 15	17 06	16 57	16 46	16 33	16 19	16 03	15 43	15 18	14 44	13 46
8	18 33	18 25	18 18	18 09	18 00	17 50	17 38	17 25	17 10	16 52	16 30	16 02	15 21	■
9	19 33	19 26	19 18	19 10	19 01	18 51	18 40	18 28	18 14	17 57	17 37	17 11	16 35	15 21
10	20 35	20 29	20 22	20 15	20 07	19 59	19 49	19 38	19 26	19 12	18 55	18 35	18 09	17 32
11	21 37	21 32	21 27	21 21	21 15	21 08	21 00	20 52	20 42	20 31	20 18	20 03	19 45	19 22
12	22 38	22 34	22 30	22 26	22 21	22 16	22 11	22 04	21 57	21 49	21 41	21 30	21 18	21 03
13	23 38	23 35	23 33	23 30	23 27	23 23	23 20	23 16	23 11	23 06	23 00	22 54	22 46	22 38
14	...	...	...	...	...	...	...	...	...	...	...	...	...	...
15	0 36	0 35	0 33	0 32	0 31	0 29	0 27	0 25	0 23	0 21	0 18	0 15	0 12	0 08
16	1 34	1 34	1 34	1 34	1 34	1 34	1 34	1 35	1 35	1 35	1 35	1 35	1 35	1 36
17	2 32	2 33	2 35	2 36	2 38	2 40	2 42	2 44	2 47	2 49	2 52	2 56	3 00	3 04

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

... indicates phenomenon will occur the next day.

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	14 11	14 08	14 06	14 04	14 02	14 01	13 58	13 56	13 54	13 51	13 49	13 47	13 45	13 44
17	15 23	15 14	15 08	15 02	14 58	14 54	14 47	14 40	14 35	14 29	14 23	14 16	14 12	14 08
18	16 36	16 22	16 12	16 03	15 55	15 48	15 37	15 27	15 18	15 08	14 59	14 48	14 41	14 34
19	17 51	17 32	17 17	17 05	16 54	16 45	16 29	16 16	16 03	15 51	15 37	15 22	15 14	15 04
20	19 07	18 42	18 23	18 08	17 55	17 44	17 24	17 08	16 52	16 37	16 20	16 01	15 51	15 38
21	20 20	19 51	19 29	19 11	18 56	18 43	18 21	18 02	17 44	17 27	17 08	16 46	16 34	16 19
22	21 26	20 54	20 30	20 11	19 56	19 42	19 18	18 58	18 39	18 21	18 00	17 37	17 24	17 08
23	22 20	21 49	21 26	21 07	20 51	20 38	20 15	19 55	19 36	19 17	18 57	18 34	18 21	18 05
24	23 00	22 33	22 13	21 56	21 42	21 30	21 08	20 50	20 33	20 16	19 57	19 36	19 23	19 09
25	23 30	23 09	22 52	22 38	22 27	22 16	21 58	21 43	21 28	21 14	20 58	20 40	20 30	20 17
26	23 53	23 37	23 25	23 15	23 06	22 58	22 45	22 33	22 22	22 11	21 59	21 45	21 37	21 28
27	.. ..	.. ..	23 53	23 47	23 41	23 36	23 28	23 20	23 13	23 06	22 58	22 50	22 44	22 39
28	0 11	0 01	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	23 57	23 54	23 52	23 49
29	0 26	0 22	0 19	0 17	0 14	0 12	0 09	0 06	0 03	0 00	.. ..	.. ..	.. ..	.. ..
30	0 41	0 43	0 44	0 46	0 47	0 48	0 49	0 51	0 52	0 54	0 56	0 57	0 59	1 00
Dec. 1	0 56	1 04	1 10	1 15	1 20	1 24	1 30	1 37	1 42	1 48	1 55	2 02	2 06	2 11
2	1 14	1 27	1 38	1 47	1 55	2 02	2 14	2 24	2 34	2 44	2 55	3 07	3 15	3 23
3	1 35	1 55	2 10	2 23	2 34	2 43	3 00	3 14	3 28	3 42	3 57	4 14	4 24	4 35
4	2 04	2 29	2 48	3 04	3 18	3 30	3 50	4 08	4 24	4 41	4 59	5 20	5 32	5 46
5	2 43	3 12	3 35	3 53	4 08	4 21	4 44	5 04	5 22	5 40	6 00	6 23	6 37	6 52
6	3 34	4 05	4 29	4 48	5 04	5 17	5 41	6 01	6 20	6 39	6 59	7 22	7 36	7 52
7	4 38	5 08	5 30	5 48	6 03	6 16	6 38	6 58	7 16	7 34	7 53	8 15	8 28	8 43
8	5 50	6 16	6 35	6 51	7 04	7 16	7 36	7 53	8 09	8 25	8 42	9 01	9 13	9 26
9	7 05	7 25	7 41	7 54	8 05	8 14	8 31	8 45	8 58	9 11	9 25	9 41	9 51	10 01
10	8 20	8 35	8 46	8 56	9 04	9 11	9 23	9 34	9 44	9 54	10 05	10 17	10 24	10 31

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	1 30	1 30	1 31	1 31	1 31	1 32	1 32	1 32	1 33	1 33	1 33	1 33	1 34	1 34
17	1 42	1 47	1 51	1 55	1 58	2 00	2 05	2 09	2 13	2 17	2 21	2 26	2 29	2 32
18	1 55	2 05	2 13	2 20	2 25	2 31	2 40	2 48	2 55	3 03	3 11	3 20	3 25	3 31
19	2 10	2 25	2 37	2 47	2 56	3 03	3 17	3 28	3 39	3 50	4 02	4 15	4 23	4 32
20	2 29	2 49	3 06	3 19	3 30	3 40	3 57	4 12	4 26	4 40	4 56	5 13	5 23	5 35
21	2 55	3 20	3 40	3 56	4 10	4 22	4 42	5 00	5 17	5 33	5 51	6 12	6 24	6 38
22	3 30	4 00	4 23	4 41	4 56	5 10	5 32	5 52	6 10	6 29	6 49	7 11	7 25	7 40
23	4 19	4 51	5 15	5 34	5 50	6 04	6 27	6 48	7 06	7 25	7 46	8 09	8 23	8 38
24	5 23	5 54	6 16	6 35	6 50	7 03	7 26	7 45	8 03	8 21	8 41	9 03	9 16	9 31
25	6 39	7 05	7 25	7 41	7 55	8 06	8 26	8 44	9 00	9 16	9 33	9 52	10 03	10 16
26	8 03	8 23	8 38	8 51	9 02	9 11	9 27	9 41	9 54	10 07	10 21	10 36	10 45	10 55
27	9 28	9 42	9 53	10 02	10 09	10 16	10 27	10 37	10 46	10 56	11 05	11 16	11 23	11 30
28	10 54	11 02	11 07	11 12	11 16	11 20	11 26	11 32	11 37	11 42	11 47	11 53	11 57	12 00
29	12 20	12 21	12 22	12 23	12 23	12 24	12 25	12 26	12 26	12 27	12 28	12 29	12 29	12 30
30	13 46	13 41	13 37	13 34	13 31	13 28	13 24	13 20	13 16	13 12	13 08	13 04	13 01	12 59
Dec. 1	15 13	15 02	14 53	14 45	14 39	14 33	14 23	14 15	14 07	13 59	13 50	13 41	13 35	13 29
2	16 41	16 23	16 09	15 57	15 47	15 39	15 24	15 11	14 59	14 48	14 35	14 20	14 12	14 03
3	18 06	17 43	17 24	17 09	16 56	16 45	16 26	16 10	15 55	15 39	15 23	15 04	14 53	14 41
4	19 27	18 58	18 36	18 18	18 03	17 50	17 28	17 09	16 52	16 34	16 15	15 53	15 40	15 26
5	20 35	20 04	19 40	19 21	19 06	18 52	18 29	18 09	17 50	17 31	17 11	16 47	16 33	16 18
6	21 28	20 58	20 35	20 17	20 02	19 48	19 25	19 05	18 47	18 28	18 08	17 45	17 31	17 16
7	22 07	21 41	21 20	21 04	20 50	20 38	20 17	19 59	19 42	19 24	19 06	18 45	18 32	18 18
8	22 35	22 13	21 57	21 43	21 31	21 21	21 03	20 48	20 33	20 18	20 02	19 44	19 33	19 21
9	22 55	22 39	22 26	22 16	22 07	21 58	21 44	21 32	21 21	21 09	20 56	20 42	20 33	20 24
10	23 11	23 00	22 51	22 44	22 38	22 32	22 22	22 13	22 05	21 57	21 48	21 38	21 32	21 25

.. .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

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UNIVERSAL TIME FOR MERIDIAN OF GREENWICH
MOONRISE

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	13 44	13 43	13 42	13 41	13 41	13 40	13 39	13 38	13 36	13 35	13 34	13 32	13 30	13 28
17	14 08	14 06	14 04	14 02	13 59	13 57	13 54	13 51	13 48	13 44	13 40	13 35	13 30	13 24
18	14 34	14 31	14 27	14 24	14 20	14 16	14 11	14 06	14 00	13 54	13 47	13 39	13 30	13 19
19	15 04	14 59	14 54	14 49	14 44	14 38	14 32	14 24	14 16	14 07	13 57	13 45	13 31	13 15
20	15 38	15 33	15 27	15 20	15 13	15 06	14 57	14 48	14 37	14 25	14 12	13 55	13 35	13 10
21	16 19	16 13	16 06	15 58	15 50	15 41	15 31	15 20	15 07	14 52	14 34	14 13	13 45	13 05
22	17 08	17 01	16 53	16 45	16 36	16 26	16 15	16 03	15 48	15 31	15 11	14 44	14 08	12 55
23	18 05	17 58	17 50	17 42	17 33	17 23	17 12	16 59	16 45	16 27	16 07	15 40	15 02	□
24	19 09	19 03	18 56	18 48	18 40	18 31	18 21	18 09	17 56	17 41	17 23	17 00	16 31	15 45
25	20 17	20 12	20 06	20 00	19 53	19 46	19 37	19 28	19 18	19 06	18 52	18 35	18 14	17 48
26	21 28	21 24	21 19	21 15	21 10	21 04	20 58	20 51	20 44	20 35	20 26	20 14	20 01	19 45
27	22 39	22 36	22 33	22 30	22 27	22 24	22 20	22 16	22 11	22 06	22 00	21 54	21 46	21 37
28	23 49	23 48	23 47	23 46	23 45	23 43	23 42	23 40	23 39	23 37	23 34	23 32	23 29	23 26
29	...	...	...	...	...	...	...	...	...	...	...	...	...	...
30	1 00	1 00	1 01	1 02	1 02	1 03	1 04	1 05	1 06	1 07	1 08	1 10	1 11	1 13
Dec. 1	2 11	2 13	2 15	2 18	2 20	2 23	2 27	2 30	2 34	2 38	2 43	2 48	2 55	3 02
2	3 23	3 27	3 30	3 35	3 39	3 44	3 50	3 56	4 03	4 10	4 19	4 29	4 41	4 56
3	4 35	4 40	4 46	4 52	4 58	5 05	5 13	5 22	5 32	5 43	5 56	6 12	6 31	6 55
4	5 46	5 52	5 59	6 06	6 14	6 23	6 33	6 44	6 57	7 12	7 29	7 51	8 19	9 01
5	6 52	6 59	7 07	7 15	7 24	7 34	7 46	7 58	8 13	8 30	8 51	9 18	9 57	■
6	7 52	7 59	8 07	8 15	8 25	8 35	8 46	8 59	9 14	9 32	9 53	10 20	11 00	■
7	8 43	8 50	8 57	9 05	9 13	9 23	9 33	9 45	9 59	10 14	10 33	10 56	11 27	12 15
8	9 26	9 32	9 38	9 44	9 52	10 00	10 09	10 19	10 30	10 43	10 57	11 15	11 37	12 06
9	10 01	10 06	10 11	10 16	10 22	10 29	10 36	10 43	10 52	11 02	11 13	11 26	11 41	12 00
10	10 31	10 35	10 39	10 43	10 47	10 52	10 57	11 02	11 08	11 15	11 23	11 32	11 42	11 55

MOONSET

	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Nov. 16	1 34	1 34	1 34	1 34	1 34	1 34	1 34	1 35	1 35	1 35	1 35	1 35	1 35	1 36
17	2 32	2 33	2 35	2 36	2 38	2 40	2 42	2 44	2 47	2 49	2 52	2 56	3 00	3 04
18	3 31	3 34	3 37	3 40	3 43	3 47	3 51	3 55	4 00	4 05	4 11	4 18	4 27	4 36
19	4 32	4 36	4 40	4 45	4 50	4 55	5 01	5 08	5 15	5 24	5 33	5 44	5 57	6 13
20	5 35	5 40	5 46	5 52	5 58	6 05	6 13	6 22	6 32	6 44	6 57	7 13	7 32	7 56
21	6 38	6 44	6 51	6 58	7 06	7 15	7 25	7 36	7 48	8 03	8 20	8 41	9 09	9 48
22	7 40	7 47	7 55	8 03	8 12	8 21	8 32	8 45	8 59	9 16	9 36	10 02	10 38	11 51
23	8 38	8 46	8 53	9 01	9 11	9 21	9 32	9 45	9 59	10 17	10 38	11 04	11 42	□
24	9 31	9 37	9 45	9 52	10 01	10 10	10 21	10 32	10 46	11 01	11 20	11 43	12 13	12 58
25	10 16	10 22	10 28	10 35	10 42	10 50	10 59	11 09	11 20	11 32	11 47	12 04	12 25	12 53
26	10 55	11 00	11 05	11 10	11 16	11 22	11 28	11 36	11 44	11 53	12 04	12 16	12 30	12 48
27	11 30	11 33	11 36	11 40	11 44	11 48	11 52	11 57	12 03	12 09	12 16	12 24	12 33	12 43
28	12 00	12 02	12 04	12 06	12 08	12 10	12 13	12 15	12 18	12 21	12 25	12 29	12 33	12 39
29	12 30	12 30	12 30	12 30	12 30	12 31	12 31	12 31	12 32	12 32	12 33	12 33	12 34	12 34
30	12 59	12 57	12 56	12 54	12 53	12 51	12 49	12 47	12 45	12 43	12 40	12 37	12 34	12 30
Dec. 1	13 29	13 26	13 23	13 20	13 17	13 13	13 09	13 05	13 00	12 55	12 49	12 42	12 34	12 25
2	14 03	13 58	13 54	13 49	13 44	13 38	13 32	13 25	13 18	13 09	12 59	12 48	12 35	12 20
3	14 41	14 36	14 30	14 23	14 16	14 09	14 00	13 51	13 41	13 29	13 15	12 59	12 39	12 14
4	15 26	15 19	15 12	15 05	14 56	14 47	14 37	14 25	14 12	13 57	13 39	13 17	12 48	12 06
5	16 18	16 11	16 03	15 54	15 45	15 35	15 24	15 11	14 56	14 39	14 18	13 51	13 12	■
6	17 16	17 09	17 01	16 53	16 43	16 33	16 22	16 09	15 54	15 37	15 16	14 48	14 09	■
7	18 18	18 11	18 04	17 57	17 48	17 39	17 29	17 17	17 04	16 49	16 30	16 08	15 37	14 50
8	19 21	19 16	19 10	19 03	18 56	18 49	18 40	18 31	18 20	18 08	17 53	17 36	17 15	16 47
9	20 24	20 20	20 15	20 10	20 05	19 59	19 52	19 45	19 37	19 28	19 18	19 05	18 51	18 33
10	21 25	21 22	21 19	21 15	21 11	21 07	21 03	20 58	20 53	20 46	20 39	20 31	20 22	20 11

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

... .. indicates phenomenon will occur the next day.

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MOONRISE AND MOONSET, 2010

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

Lat.		-55°	-50°	-45°	-40°	-35°	-30°	-20°	-10°	0°	+10°	+20°	+30°	+35°	+40°
		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec.	9	7 05	7 25	7 41	7 54	8 05	8 14	8 31	8 45	8 58	9 11	9 25	9 41	9 51	10 01
	10	8 20	8 35	8 46	8 56	9 04	9 11	9 23	9 34	9 44	9 54	10 05	10 17	10 24	10 31
	11	9 33	9 42	9 50	9 56	10 01	10 06	10 14	10 21	10 27	10 34	10 40	10 48	10 53	10 58
	12	10 44	10 48	10 52	10 54	10 57	10 59	11 02	11 05	11 08	11 11	11 14	11 18	11 20	11 22
	13	11 55	11 54	11 53	11 52	11 51	11 51	11 50	11 49	11 49	11 48	11 47	11 47	11 46	11 46
	14	13 05	12 59	12 54	12 50	12 46	12 43	12 38	12 34	12 29	12 25	12 20	12 15	12 12	12 09
	15	14 17	14 05	13 56	13 49	13 43	13 37	13 27	13 19	13 11	13 03	12 55	12 46	12 40	12 34
	16	15 30	15 14	15 00	14 49	14 40	14 32	14 18	14 06	13 55	13 44	13 32	13 18	13 11	13 02
	17	16 46	16 23	16 06	15 52	15 40	15 30	15 12	14 56	14 42	14 28	14 13	13 55	13 45	13 34
	18	18 00	17 33	17 12	16 55	16 41	16 29	16 08	15 50	15 33	15 16	14 58	14 37	14 26	14 12
	19	19 11	18 40	18 16	17 58	17 42	17 28	17 05	16 45	16 27	16 09	15 49	15 26	15 13	14 58
	20	20 11	19 39	19 15	18 56	18 40	18 27	18 03	17 43	17 24	17 05	16 45	16 21	16 08	15 52
	21	20 57	20 29	20 07	19 49	19 34	19 22	18 59	18 40	18 22	18 04	17 45	17 23	17 10	16 55
	22	21 32	21 09	20 50	20 35	20 23	20 11	19 52	19 36	19 20	19 04	18 47	18 28	18 17	18 04
	23	21 58	21 40	21 26	21 15	21 05	20 56	20 41	20 28	20 16	20 03	19 50	19 35	19 26	19 16
	24	22 18	22 06	21 57	21 49	21 43	21 37	21 27	21 18	21 09	21 01	20 52	20 41	20 35	20 28
	25	22 34	22 28	22 24	22 20	22 17	22 14	22 09	22 05	22 00	21 56	21 52	21 47	21 44	21 40
	26	22 49	22 49	22 49	22 49	22 50	22 50	22 50	22 50	22 50	22 51	22 51	22 51	22 51	22 52
	27	23 04	23 10	23 14	23 18	23 22	23 25	23 31	23 35	23 40	23 45	23 49	23 55	23 58	...
	28	23 20	23 32	23 41	23 49	23 56	...	...	...	...	...	...	...	...	0 02
	29	23 40	23 57	...	...	...	0 02	0 12	0 22	0 30	0 39	0 49	0 59	1 06	1 13
	30	...	...	0 11	0 23	0 33	0 41	0 56	1 10	1 22	1 35	1 48	2 04	2 13	2 24
	31	0 05	0 28	0 46	1 01	1 14	1 25	1 44	2 01	2 16	2 32	2 49	3 08	3 20	3 33
	32	0 39	1 07	1 28	1 46	2 00	2 13	2 35	2 54	3 12	3 30	3 49	4 12	4 25	4 40
	33	1 24	1 55	2 18	2 37	2 53	3 06	3 29	3 50	4 09	4 27	4 48	5 11	5 25	5 41

MOONSET

		h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
Dec.	9	22 55	22 39	22 26	22 16	22 07	21 58	21 44	21 32	21 21	21 09	20 56	20 42	20 33	20 24
	10	23 11	23 00	22 51	22 44	22 38	22 32	22 22	22 13	22 05	21 57	21 48	21 38	21 32	21 25
	11	23 25	23 18	23 14	23 09	23 06	23 02	22 57	22 52	22 47	22 42	22 37	22 31	22 28	22 24
	12	23 37	23 35	23 34	23 33	23 32	23 31	23 30	23 29	23 28	23 27	23 25	23 24	23 23	23 22
	13	23 48	23 51	23 54	23 56	23 58	...	...	...	...	...	...	...	...	...
	14	...	...	...	...	...	0 00	0 03	0 06	0 08	0 11	0 13	0 16	0 18	0 20
	15	0 00	0 08	0 15	0 20	0 25	0 29	0 37	0 43	0 49	0 55	1 02	1 09	1 13	1 18
	16	0 14	0 27	0 38	0 46	0 54	1 01	1 12	1 22	1 32	1 41	1 52	2 03	2 10	2 18
	17	0 31	0 50	1 04	1 16	1 26	1 35	1 51	2 04	2 17	2 30	2 44	2 59	3 09	3 19
	18	0 54	1 17	1 36	1 51	2 03	2 14	2 34	2 50	3 06	3 22	3 38	3 58	4 09	4 22
	19	1 25	1 53	2 15	2 32	2 47	3 00	3 22	3 41	3 58	4 16	4 35	4 57	5 10	5 25
	20	2 08	2 39	3 03	3 22	3 38	3 52	4 15	4 35	4 54	5 13	5 33	5 56	6 10	6 26
	21	3 07	3 38	4 02	4 21	4 36	4 50	5 13	5 33	5 52	6 10	6 30	6 53	7 07	7 22
	22	4 21	4 48	5 10	5 27	5 41	5 54	6 15	6 33	6 50	7 07	7 25	7 46	7 58	8 11
	23	5 44	6 06	6 24	6 38	6 49	7 00	7 17	7 33	7 47	8 01	8 16	8 33	8 43	8 54
	24	7 12	7 28	7 40	7 50	7 59	8 07	8 20	8 31	8 41	8 52	9 03	9 15	9 23	9 31
	25	8 40	8 49	8 57	9 03	9 08	9 13	9 20	9 27	9 34	9 40	9 47	9 54	9 58	10 03
	26	10 07	10 10	10 12	10 14	10 16	10 17	10 20	10 22	10 24	10 26	10 28	10 30	10 32	10 33
	27	11 33	11 30	11 27	11 25	11 23	11 22	11 19	11 16	11 14	11 11	11 09	11 06	11 04	11 02
	28	12 59	12 50	12 42	12 36	12 31	12 26	12 18	12 10	12 04	11 57	11 50	11 42	11 37	11 32
	29	14 25	14 09	13 57	13 47	13 38	13 30	13 17	13 05	12 55	12 44	12 33	12 20	12 12	12 04
	30	15 50	15 28	15 11	14 57	14 45	14 35	14 17	14 02	13 48	13 33	13 18	13 01	12 51	12 40
	31	17 10	16 43	16 22	16 05	15 51	15 39	15 18	15 00	14 43	14 26	14 08	13 47	13 35	13 21
	32	18 22	17 51	17 28	17 10	16 54	16 40	16 18	15 58	15 39	15 20	15 01	14 38	14 24	14 09
	33	19 20	18 49	18 26	18 07	17 52	17 38	17 15	16 54	16 36	16 17	15 56	15 33	15 19	15 03

... .. indicates phenomenon will occur the next day.

MOONRISE AND MOONSET, 2010

UNIVERSAL TIME FOR MERIDIAN OF GREENWICH

MOONRISE

63

Lat.	+40°	+42°	+44°	+46°	+48°	+50°	+52°	+54°	+56°	+58°	+60°	+62°	+64°	+66°
Dec. 9	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
10	10 01	10 06	10 11	10 16	10 22	10 29	10 36	10 43	10 52	11 02	11 13	11 26	11 41	12 00
11	10 31	10 35	10 39	10 43	10 47	10 52	10 57	11 02	11 08	11 15	11 23	11 32	11 42	11 55
12	10 58	11 00	11 03	11 05	11 08	11 11	11 14	11 18	11 22	11 26	11 31	11 36	11 43	11 50
13	11 22	11 23	11 24	11 26	11 27	11 28	11 30	11 31	11 33	11 35	11 37	11 39	11 42	11 45
14	11 46	11 45	11 45	11 45	11 45	11 44	11 44	11 44	11 43	11 43	11 43	11 42	11 42	11 41
15	12 09	12 08	12 06	12 05	12 03	12 01	11 59	11 57	11 54	11 51	11 48	11 45	11 41	11 36
16	12 34	12 31	12 29	12 26	12 22	12 19	12 15	12 11	12 06	12 01	11 55	11 48	11 41	11 32
17	13 02	12 58	12 54	12 49	12 45	12 39	12 34	12 27	12 20	12 13	12 04	11 54	11 42	11 28
18	13 34	13 29	13 23	13 17	13 11	13 04	12 57	12 48	12 39	12 28	12 16	12 01	11 44	11 23
19	14 12	14 06	13 59	13 52	13 44	13 36	13 26	13 16	13 04	12 50	12 34	12 15	11 51	11 18
20	14 58	14 51	14 43	14 35	14 26	14 17	14 06	13 54	13 40	13 24	13 04	12 40	12 07	11 12
21	15 52	15 45	15 37	15 29	15 20	15 10	14 58	14 45	14 31	14 13	13 52	13 25	12 47	□
22	16 55	16 48	16 41	16 33	16 24	16 14	16 04	15 52	15 38	15 22	15 02	14 38	14 04	13 07
23	18 04	17 58	17 51	17 45	17 37	17 29	17 20	17 10	16 58	16 45	16 29	16 11	15 47	15 15
24	19 16	19 11	19 06	19 01	18 55	18 49	18 42	18 35	18 26	18 16	18 05	17 52	17 36	17 17
25	20 28	20 25	20 22	20 19	20 15	20 11	20 06	20 01	19 56	19 50	19 42	19 34	19 25	19 14
26	21 40	21 39	21 37	21 36	21 34	21 32	21 30	21 27	21 25	21 22	21 19	21 15	21 11	21 06
27	22 52	22 52	22 52	22 52	22 52	22 52	22 52	22 53	22 53	22 53	22 53	22 54	22 54	22 54
28	0 02	0 04	0 06	0 08	0 10	0 12	0 14	0 17	0 20	0 24	0 27	0 32	0 37	0 42
29	1 13	1 16	1 20	1 23	1 27	1 32	1 36	1 42	1 48	1 54	2 02	2 10	2 20	2 32
30	2 24	2 28	2 33	2 39	2 45	2 51	2 58	3 06	3 15	3 25	3 36	3 50	4 06	4 27
31	3 33	3 39	3 45	3 52	4 00	4 08	4 17	4 28	4 40	4 53	5 09	5 29	5 53	6 27
32	4 40	4 47	4 54	5 02	5 11	5 20	5 31	5 44	5 58	6 14	6 34	6 59	7 34	8 39
33	5 41	5 48	5 56	6 04	6 14	6 24	6 35	6 48	7 03	7 21	7 43	8 11	8 52	■

MOONSET

Dec.	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
9	20 24	20 20	20 15	20 10	20 05	19 59	19 52	19 45	19 37	19 28	19 18	19 05	18 51	18 33	
10	21 25	21 22	21 19	21 15	21 11	21 07	21 03	20 58	20 53	20 46	20 39	20 31	20 22	20 11	
11	22 24	22 22	22 21	22 19	22 16	22 14	22 12	22 09	22 06	22 02	21 59	21 54	21 49	21 43	
12	23 22	23 22	23 21	23 21	23 20	23 20	23 19	23 18	23 18	23 17	23 16	23 15	23 14	23 12	
13	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
14	0 20	0 21	0 22	0 23	0 24	0 25	0 26	0 28	0 29	0 31	0 33	0 35	0 37	0 40	
15	1 18	1 20	1 23	1 25	1 28	1 31	1 34	1 37	1 41	1 45	1 50	1 56	2 02	2 10	
16	2 18	2 21	2 25	2 29	2 33	2 38	2 43	2 49	2 55	3 02	3 10	3 19	3 30	3 43	
17	3 19	3 24	3 29	3 34	3 40	3 47	3 54	4 02	4 11	4 21	4 32	4 46	5 02	5 23	
18	4 22	4 28	4 34	4 41	4 48	4 57	5 06	5 16	5 27	5 40	5 56	6 15	6 38	7 10	
19	5 25	5 32	5 39	5 47	5 55	6 05	6 15	6 27	6 41	6 57	7 16	7 40	8 13	9 08	
20	6 26	6 33	6 41	6 49	6 58	7 08	7 20	7 32	7 47	8 04	8 26	8 53	9 31	□	
21	7 22	7 29	7 36	7 44	7 53	8 03	8 14	8 26	8 40	8 57	9 16	9 41	10 15	11 13	
22	8 11	8 18	8 24	8 31	8 39	8 48	8 57	9 08	9 20	9 33	9 49	10 09	10 33	11 06	
23	8 54	8 59	9 04	9 10	9 16	9 23	9 31	9 39	9 48	9 58	10 10	10 24	10 41	11 01	
24	9 31	9 34	9 38	9 42	9 47	9 52	9 57	10 03	10 09	10 16	10 24	10 33	10 44	10 57	
25	10 03	10 05	10 08	10 10	10 13	10 16	10 19	10 22	10 26	10 30	10 34	10 39	10 45	10 52	
26	10 33	10 34	10 35	10 35	10 36	10 37	10 38	10 39	10 40	10 41	10 42	10 44	10 46	10 48	
27	11 02	11 01	11 00	11 00	10 58	10 57	10 56	10 55	10 53	10 52	10 50	10 48	10 46	10 43	
28	11 32	11 30	11 27	11 24	11 22	11 19	11 15	11 12	11 08	11 03	10 58	10 52	10 46	10 38	
29	12 04	12 00	11 56	11 52	11 47	11 42	11 37	11 30	11 24	11 16	11 08	10 58	10 47	10 34	
30	12 40	12 34	12 29	12 23	12 17	12 10	12 02	11 54	11 44	11 33	11 21	11 07	10 49	10 28	
31	13 21	13 15	13 08	13 01	12 53	12 44	12 35	12 24	12 12	11 58	11 41	11 21	10 56	10 21	
32	14 09	14 02	13 54	13 46	13 37	13 27	13 16	13 04	12 49	12 33	12 13	11 47	11 12	10 07	
33	15 03	14 56	14 48	14 40	14 31	14 20	14 09	13 56	13 41	13 23	13 01	12 33	11 53	■	

□ indicates Moon continuously above horizon.

■ indicates Moon continuously below horizon.

.. .. indicates phenomenon will occur the next day.

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SUMMARY OF ECLIPSES AND TRANSITS FOR 2010

There are two eclipses of the Sun and two of the Moon in 2010. All times are expressed in Universal Time using $\Delta T = +66^s.0$. There are no transits of Mercury or Venus across the Sun in 2010.

I. *An annular eclipse of the Sun*, January 15. See map on page 71. The eclipse begins at 04^h 05^m and ends at 10^h 08^m. The maximum duration of annularity is 11^m 04^s. It is visible from Africa, the Middle East, eastern Europe, Asia, and the Indian Ocean.

II. *A partial eclipse of the Moon*, June 26. See map on page 74. The eclipse begins at 08^h 56^m and ends at 14^h 21^m; time of maximum eclipse is 11^h 38^m. It is visible from eastern Asia, Australia, Antarctica, North America, South America, and the Indian and Pacific Oceans.

III. *A total eclipse of the Sun*, July 11. See map on page 76. The eclipse begins at 17^h 10^m and ends at 21^h 57^m; maximum duration of totality is 05^m 25^s. It is visible from southern South America and the South Pacific Ocean.

IV. *A total eclipse of the Moon*, December 21. See map on page 79. The eclipse begins at 05^h 28^m and ends at 11^h 06^m; the total phase begins at 07^h 40^m and ends at 08^h 54^m. It is visible from Asia, Australia, North America, South America, Europe, western Africa, and the Pacific and Atlantic Oceans.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at <http://asa.hmnao.com> or <http://asa.usno.navy.mil>.

Local circumstances and animations for upcoming eclipses can be found on *The Astronomical Almanac Online* at <http://asa.hmnao.com> or <http://asa.usno.navy.mil>.

General Information

The elements and circumstances are computed according to Bessel's method from apparent right ascensions and declinations of the Sun and Moon. Semidiameters of the Sun and Moon used in the calculation of eclipses do not include irradiation. The adopted semidiameter of the Sun at unit distance is $15'59''64$ from the IAU (1976) Astronomical Constants. The apparent semidiameter of the Moon is equal to $\arcsin(k \sin \pi)$, where π is the Moon's horizontal parallax and k is an adopted constant. In 1982, the IAU adopted $k = 0.272\,5076$, corresponding to the mean radius of Watts' datum as determined by observations of occultations and to the adopted radius of the Earth.

Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between center of figure and center of mass.

Refraction is neglected in calculating solar and lunar eclipses. Because the circumstances of eclipses are calculated for the surface of the ellipsoid, refraction is not included in Besselian element polynomials. For local predictions, corrections for refraction are unnecessary; they are required only in precise comparisons of theory with observation in which many other refinements are also necessary.

All time arguments are given provisionally in Universal Time, using $\Delta T(A) = +66^s.0$. Once an updated value of ΔT is known, the data on these pages may be expressed in Universal Time as follows:

Define $\delta T = \Delta T - \Delta T(A)$, in units of seconds of time.

Change the times of circumstances given in preliminary Universal Time by subtracting δT .

Correct the tabulated longitudes, $\lambda(A)$, using $\lambda = \lambda(A) + 0.00417807 \times \delta T$ (longitudes are in degrees).

Leave all other quantities unchanged.

The correction of δT is included in the Besselian elements.

Longitude is positive to the east, and negative to the west.

Explanation of Solar Eclipse Diagram

The solar eclipse diagrams in *The Astronomical Almanac* show the region over which different phases of each eclipse may be seen and the times at which these phases occur. Each diagram has a series of dashed curves that show the outline of the Moon's penumbra on the Earth's surface at one-hour intervals. Short dashes show the leading edge and long dashes show the trailing edge. Except for certain extreme cases, the shadow outline moves generally from west to east. The Moon's shadow cone first contacts the Earth's surface where "First Contact" is indicated on the diagram. "Last Contact" is where the Moon's shadow cone last contacts the Earth's surface. The path of central eclipse, whether for a total, annular, or annular-total eclipse, is marked by two closely spaced curves that cut across all of the dashed curves. These two curves mark the extent of the Moon's umbral shadow on the Earth's surface. Viewers within these boundaries will observe a total, annular, or annular-total eclipse and viewers outside these boundaries will see a partial eclipse.

Solid curves labeled "Northern" and "Southern Limit of Eclipse" represent the furthest extent north or south of the Moon's penumbra on the Earth's surface. Viewers outside of these boundaries will not experience any eclipse. When only one of these two curves appears, only part of the Moon's penumbra touches the Earth; the other part is projected into space north or south of the Earth, and the terminator defines the other limit.

Another set of solid curves appears on some diagrams as two teardrop shapes (or lobes) on either end of the eclipse path, and on other diagrams as a distorted figure eight. These lobes represent in time the intersection of the Moon's penumbra with the Earth's terminator as the eclipse progresses. As time elapses, the Earth's terminator moves east-to-west while the Moon's penumbra moves west-to-east. These lobes connect to form an elongated figure eight on a diagram when part of the Moon's penumbra stays in contact with the Earth's terminator throughout the eclipse. The lobes become two separate teardrop shapes when the Moon's penumbra breaks contact with the Earth's terminator during the beginning of the eclipse and reconnects with it near the end. In the east, the outer portion of the lobe is labeled "Eclipse begins at Sunset" and marks the first contact between the Moon's penumbra and Earth's terminator in the east. Observers on this curve just fail to see the eclipse. The inner part of the lobe is labeled "Eclipse ends at Sunset" and marks the last contact between the Moon's penumbra and the Earth's terminator in the east. Observers on this curve just see the whole eclipse. The curve bisecting this lobe is labeled "Maximum Eclipse at Sunset" and is part of the sunset terminator at maximum eclipse. Viewers in the eastern half of the lobe will see the Sun set before maximum eclipse; *i.e.* see less than half of the eclipse. Viewers in the western half of the lobe will see the Sun set after maximum eclipse; *i.e.* see more than half of the eclipse. A similar description holds for the western lobe except everything occurs at sunrise instead of sunset.

Computing Local Circumstances for Solar Eclipses

The solar eclipse maps show the path of the eclipse, beginning and ending times of the eclipse, and the region of visibility, including restrictions due to rising and setting of the Sun. The short-dash and long-dash lines show, respectively, the progress of the leading and trailing edge of the penumbra; thus, at a given location, times of first and last contact may be interpolated. If further precision is desired, Besselian elements can be utilized.

Besselian elements characterize the geometric position of the shadow of the Moon relative to the Earth. The exterior tangents to the surfaces of the Sun and Moon form the umbral cone; the interior tangents form the penumbral cone. The common axis of these two cones is the axis of the shadow. To form a system of geocentric rectangular coordinates, the geocentric plane perpendicular to the axis of the shadow is taken as the xy -plane. This is called the fundamental plane. The x -axis is the intersection of the fundamental plane with the plane of the equator; it is positive toward the east. The y -axis is positive toward the north. The z -axis is parallel to the axis of the shadow and is positive toward the Moon. The tabular values of x and y are the coordinates, in units of the Earth's equatorial radius, of the intersection of the axis of the shadow with the fundamental plane. The direction of the axis of the shadow is specified by the declination d and hour angle μ of the point on the celestial sphere toward which the axis is directed.

The radius of the umbral cone is regarded as positive for an annular eclipse and negative for a total eclipse. The angles f_1 and f_2 are the angles at which the tangents that form the penumbral and umbral cones, respectively, intersect the axis of the shadow.

To predict accurate local circumstances, calculate the geocentric coordinates $\rho \sin \phi'$ and $\rho \cos \phi'$ from the geodetic latitude ϕ and longitude λ , using the relationships given on pages K11–K12 of *The Astronomical Almanac*. Inclusion of the height h in this calculation is all that is necessary to obtain the local circumstances at high altitudes.

Obtain approximate times for the beginning, middle and end of the eclipse from the eclipse map. For each of these three times compute from the Besselian element polynomials, the values of x , y , $\sin d$, $\cos d$, μ and l_1 (the radius of the penumbra on the fundamental plane), except that at the approximate time of the middle of the eclipse l_2 (the radius of the umbra on the fundamental plane) is required instead of l_1 if the eclipse

is central (i.e., total, annular or annular-total). The hourly variations x' , y' of x and y are needed, and may be obtained by evaluating the derivative of the polynomial expressions for x and y . Values of μ' , d' , $\tan f_1$ and $\tan f_2$ are nearly constant throughout the eclipse and are given immediately following the Besselian polynomials.

For each of the three approximate times, calculate the coordinates ξ , η , ζ for the observer and the hourly variations ξ' and η' from

$$\begin{aligned}\xi &= \rho \cos \phi' \sin \theta, \\ \eta &= \rho \sin \phi' \cos d - \rho \cos \phi' \sin d \cos \theta, \\ \zeta &= \rho \sin \phi' \sin d + \rho \cos \phi' \cos d \cos \theta, \\ \xi' &= \mu' \rho \cos \phi' \cos \theta, \\ \eta' &= \mu' \xi \sin d - \zeta d',\end{aligned}$$

where

$$\theta = \mu + \lambda$$

for longitudes measured positive towards the east.

Next, calculate

$$\begin{aligned}u &= x - \xi & u' &= x' - \xi' \\ v &= y - \eta & v' &= y' - \eta' \\ m^2 &= u^2 + v^2 & n^2 &= u'^2 + v'^2 \\ L_i &= l_i - \zeta \tan f_i \\ D &= uu' + vv' \\ \Delta &= \frac{1}{n}(uv' - u'v) \\ \sin \psi &= \frac{\Delta}{L_i}\end{aligned} \quad (m, n > 0)$$

where $i = 1, 2$.

At the approximate times of the beginning and end of the eclipse, L_1 is required. At the approximate time of the middle of the eclipse, L_2 is required if the eclipse is central; L_1 is required if the eclipse is partial.

Neglecting the variation of L , the correction τ to be applied to the approximate time of the middle of the eclipse to obtain the *Universal Time of greatest phase* is

$$\tau = -\frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60. The correction τ to be applied to the approximate times of the beginning and end of the eclipse to obtain the *Universal Times of the penumbral contacts* is

$$\tau = \frac{L_1}{n} \cos \psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

If the eclipse is central, use the approximate time for the middle of the eclipse as a first approximation to the times of umbral contact. The correction τ to be applied to obtain the *Universal Times of the umbral contacts* is

$$\tau = \frac{L_2}{n} \cos \psi - \frac{D}{n^2},$$

which may be expressed in minutes by multiplying by 60.

In the last two equations, the ambiguity in the quadrant of ψ is removed by noting that $\cos \psi$ must be *negative* for the beginning of the eclipse, for the beginning of the annular

phase, or for the end of the total phase; $\cos \psi$ must be *positive* for the end of the eclipse, the end of the annular phase, or the beginning of the total phase.

For greater accuracy, the times resulting from the calculation outlined above should be used in place of the original approximate times, and the entire procedure repeated at least once. The calculations for each of the contact times and the time of greatest phase should be performed separately.

The *magnitude of greatest partial eclipse*, in units of the solar diameter is

$$M_1 = \frac{L_1 - m}{(2L_1 - 0.5459)},$$

where the value of m at the time of greatest phase is used. If the magnitude is negative at the time of greatest phase, no eclipse is visible from the location.

The *magnitude of the central phase*, in the same units is

$$M_2 = \frac{L_1 - L_2}{(L_1 + L_2)}.$$

The *position angle of a point of contact* measured eastward (counterclockwise) from the north point of the solar limb is given by

$$\tan P = \frac{u}{v},$$

where u and v are evaluated at the times of contacts computed in the final approximation. The quadrant of P is determined by noting that $\sin P$ has the algebraic sign of u , except for the contacts of the total phase, for which $\sin P$ has the opposite sign to u .

The position angle of the point of contact measured eastward from the vertex of the solar limb is given by

$$V = P - C,$$

where C , the parallactic angle, is obtained with sufficient accuracy from

$$\tan C = \frac{\xi}{\eta},$$

with $\sin C$ having the same algebraic sign as ξ , and the results of the final approximation again being used. The vertex point of the solar limb lies on a great circle arc drawn from the zenith to the center of the solar disk.

Lunar Eclipses

A calculator to produce local circumstances of recent and upcoming lunar eclipses is provided at <http://aa.usno.navy.mil/data/docs/LunarEclipse.php>.

In calculating lunar eclipses the radius of the geocentric shadow of the Earth is increased by one-fiftieth part to allow for the effect of the atmosphere. Refraction is neglected in calculating solar and lunar eclipses. Standard corrections of $+0''.5$ and $-0''.25$ have been applied to the longitude and latitude of the Moon, respectively, to help correct for the difference between center of figure and center of mass.

Explanation of Lunar Eclipse Diagram

Information on lunar eclipses is presented in the form of a diagram consisting of two parts. The upper panel shows the path of the Moon relative to the penumbral and umbral shadows of the Earth. The lower panel shows the visibility of the eclipse from the surface of the Earth.

The title of the upper panel includes the type of eclipse, its place in the sequence of eclipses for the year and the Greenwich calendar date of the eclipse. The inner darker circle is the umbral shadow of the Earth and the outer lighter circle is that of the penumbra. The axis of the shadow of the Earth is denoted by (+) with the ecliptic shown for reference purposes. A 30-arcminute scale bar is provided on the right hand side of the diagram and the orientation is given by the cardinal points displayed on the small graphic on the left hand side of the diagram. The position angle (PA) is measured from North point of the lunar disk along the limb of the Moon to the point of contact. It is shown on the graphic by the use of an arc extending anti-clockwise (eastwards) from North terminated with an arrow head.

Moon symbols are plotted at the principal phases of the eclipse to show its position relative to the umbral and penumbral shadows. The UT times of the different phases of the eclipse to the nearest tenth of a minute are printed above or below the Moon symbols as appropriate. P1 and P4 are the first and last external contacts of the penumbra respectively and denote the beginning and end of the penumbral eclipse respectively. U1 and U4 are the first and last external contacts of the umbra denoting the beginning and end of the partial phase of the eclipse respectively. U2 and U3 are the first and last internal contacts of the umbra and denote the beginning and end of the total phase respectively. MID is the middle of the eclipse. The position angle is given for P1 and P4 for penumbral eclipses and U1 and U4 for partial and total eclipses. The UT time of the geocentric opposition in right ascension of the Sun and Moon and the magnitude of the eclipse are given above or below the Moon symbols as appropriate.

The lower panel is a cylindrical equidistant map projection showing the Earth centered on the longitude at which the Moon is in the zenith at the middle of the eclipse. The visibility of the eclipse is displayed by plotting the Moon rise/set terminator for the principal phases of the eclipse for which timing information is provided in the upper panel. The terminator for the middle of the eclipse is not plotted for the sake of clarity.

The unshaded area indicates the region of the Earth from which all the eclipse is visible whereas the darkest shading indicates the area from which the eclipse is invisible. The different shades of gray indicate regions where the Moon is either rising or setting during the principal phases of the eclipse. The Moon is rising on the left hand side of the diagram after the eclipse has started and is setting on the right hand side of the diagram before the eclipse ends. Labels are provided to this effect.

Symbols are plotted showing the locations for which the Moon is in the zenith at the principal phases of the eclipse. The points at which the Moon is in the zenith at P1 and P4 are denoted by (+), at U1 and U4 by (\odot) and at U2 and U3 by (\oplus). These symbols are also plotted on the upper panel where appropriate. The value of ΔT used for the calculation of the eclipse circumstances is given below the diagram. Country boundaries are also provided to assist the user in determining the visibility of the eclipse at a particular location.

I. –Annular Eclipse of the Sun, 2010 January 15

CIRCUMSTANCES OF THE ECLIPSE

UT of geocentric conjunction in right ascension, January 15^d 7^h 20^m 20^s.230
Julian Date = 2455211.8057896990

		UT			Longitude		Latitude
		^d	^h	^m	[°]	[']	[°]
Eclipse begins	January	15	4	05.4	+	30 27.0	− 1 19.5
Beginning of southern limit of umbra		15	5	16.8	+	15 12.6	+ 5 21.9
Beginning of center line; central eclipse begins		15	5	17.6	+	15 38.8	+ 6 58.3
Beginning of northern limit of umbra		15	5	18.4	+	16 04.1	+ 8 36.0
Central Eclipse at Local Apparent Noon		15	7	20.3	+	72 14.8	+ 3 30.9
End of northern limit of umbra		15	8	54.5	+120	54.4	+38 22.9
End of center line; central eclipse ends		15	8	55.4	+121	41.2	+36 49.3
End of southern limit of umbra		15	8	56.2	+122	26.6	+35 16.4
Eclipse ends		15	10	07.6	+108	11.6	+28 47.9

BESSELIAN ELEMENTS

Let $t = (\text{UT} - 4^{\text{h}}) + \delta T / 3600$ in units of hours.

These equations are valid over the range $0^{\text{h}}.042 \leq t \leq 6^{\text{h}}.300$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of axis of shadow with fundamental plane:

$$\begin{aligned}x &= -1.61797405 + 0.48459845\,t + 0.00001103\,t^2 - 0.00000538\,t^3 \\y &= -0.05146548 + 0.13974866\,t + 0.00013228\,t^2 - 0.00000170\,t^3\end{aligned}$$

Direction of axis of shadow:

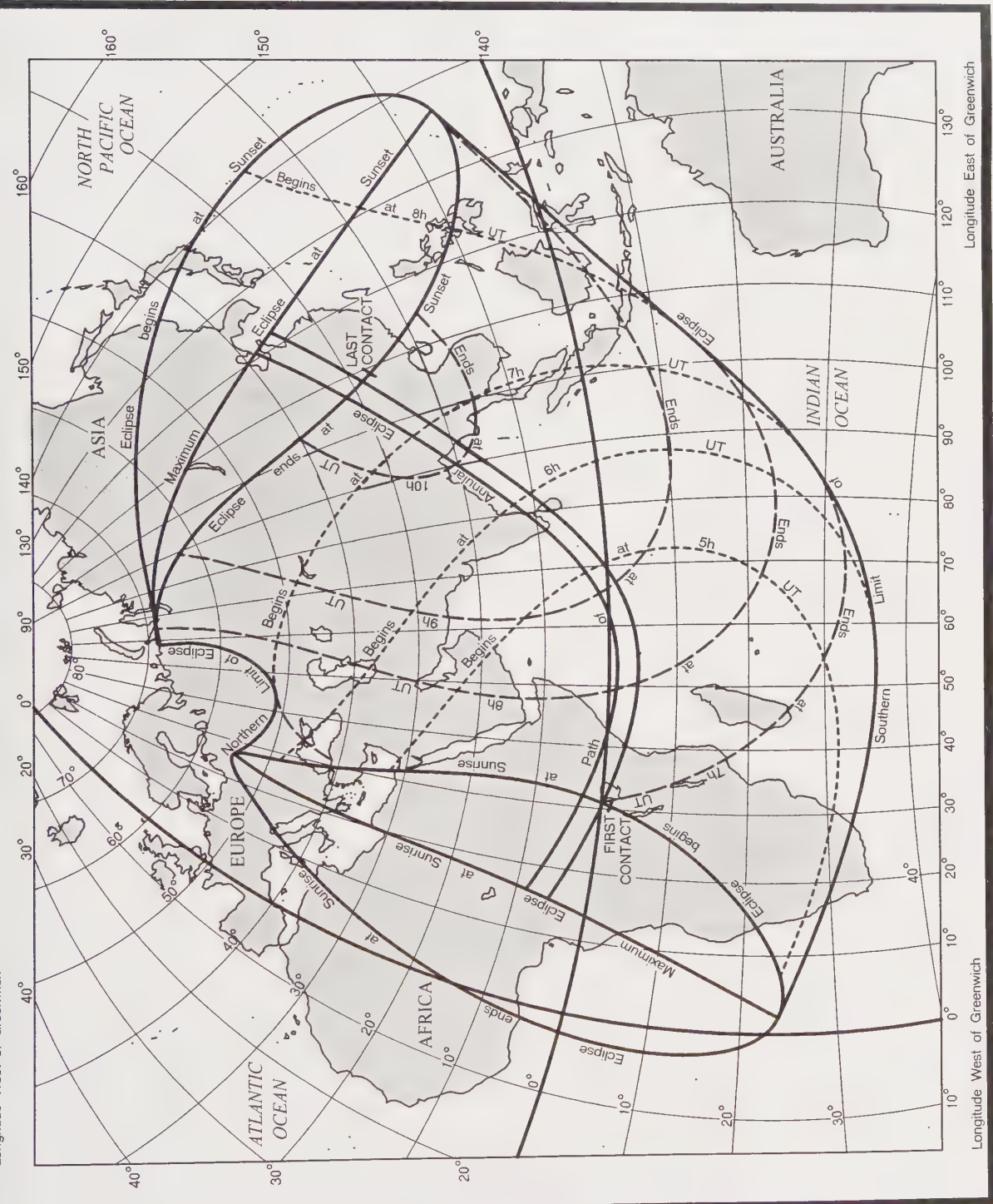
$$\begin{aligned}\sin d &= -0.36082773 + 0.00011836\,t + 0.00000011\,t^2 \\ \cos d &= +0.93263247 + 0.00004580\,t + 0.00000003\,t^2 \\ \mu &= 237^{\circ}.67754487 + 14.99757842\,t + 0.00000209\,t^2 - 0.00417807\,\delta T\end{aligned}$$

Radius of shadow on fundamental plane:

$$\begin{aligned}\text{penumbra } (l_1) &= +0.57449909 + 0.00009647\,t - 0.00000994\,t^2 \\ \text{umbra } (l_2) &= +0.02797322 + 0.00009594\,t - 0.00000988\,t^2\end{aligned}$$

$$\begin{aligned}\tan f_1 &= +0.004755 \\ \tan f_2 &= +0.004731 \\ \mu' &= +0.261757 \text{ radians per hour} \\ d' &= +0.000128 \text{ radians per hour}\end{aligned}$$

ANNULAR SOLAR ECLIPSE OF 2010 JANUARY 15



PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF JANUARY 15

For limits, see Circumstances of the Eclipse

Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
+ 20 00	+ 7 04.1	+ 5 18.0	+ 3 33.4	5 18 52.0	5 18 00.4	5 17 20.8	7 18.7	5	112
+ 21 00	+ 6 40.9	+ 4 55.5	+ 3 11.1	5 19 01.7	5 18 15.9	5 17 33.8	7 21.9	6	112
+ 22 00	+ 6 18.0	+ 4 33.1	+ 2 49.2	5 19 17.4	5 18 31.6	5 17 51.8	7 25.1	7	112
+ 23 00	+ 5 55.5	+ 4 10.9	+ 2 27.5	5 19 37.6	5 18 51.9	5 18 13.3	7 28.5	8	112
+ 24 00	+ 5 33.2	+ 3 49.1	+ 2 06.1	5 20 00.5	5 19 15.7	5 18 37.9	7 32.0	9	112
+ 25 00	+ 5 11.2	+ 3 27.5	+ 1 44.9	5 20 26.8	5 19 42.9	5 19 05.9	7 35.5	10	112
+ 26 00	+ 4 49.4	+ 3 06.1	+ 1 24.0	5 20 56.8	5 20 13.7	5 19 37.3	7 39.2	12	112
+ 27 00	+ 4 27.9	+ 2 45.1	+ 1 03.5	5 21 30.4	5 20 48.0	5 20 12.3	7 43.1	13	112
+ 28 00	+ 4 06.8	+ 2 24.5	+ 0 43.3	5 22 07.8	5 21 26.1	5 20 50.9	7 47.0	14	112
+ 29 00	+ 3 46.0	+ 2 04.1	+ 0 23.4	5 22 49.2	5 22 08.0	5 21 33.3	7 51.1	15	113
+ 30 00	+ 3 25.6	+ 1 44.2	+ 0 03.9	5 23 34.5	5 22 53.8	5 22 19.6	7 55.3	16	113
+ 31 00	+ 3 05.6	+ 1 24.7	- 0 15.2	5 24 24.1	5 23 43.7	5 23 09.8	7 59.6	18	113
+ 32 00	+ 2 46.1	+ 1 05.6	- 0 33.8	5 25 17.8	5 24 37.7	5 24 04.0	8 04.0	19	113
+ 33 00	+ 2 27.0	+ 0 46.9	- 0 52.0	5 26 16.0	5 25 36.0	5 25 02.4	8 08.6	20	113
+ 34 00	+ 2 08.4	+ 0 28.8	- 1 09.7	5 27 18.7	5 26 38.8	5 26 05.1	8 13.4	21	113
+ 35 00	+ 1 50.3	+ 0 11.2	- 1 26.8	5 28 26.1	5 27 46.0	5 27 12.2	8 18.2	23	113
+ 36 00	+ 1 32.8	- 0 05.9	- 1 43.4	5 29 38.2	5 28 57.9	5 28 23.8	8 23.3	24	113
+ 37 00	+ 1 15.9	- 0 22.4	- 1 59.5	5 30 55.3	5 30 14.5	5 29 39.9	8 28.4	25	113
+ 38 00	+ 0 59.6	- 0 38.2	- 2 14.9	5 32 17.4	5 31 36.1	5 31 00.9	8 33.7	27	113
+ 39 00	+ 0 44.0	- 0 53.4	- 2 29.6	5 33 44.8	5 33 02.7	5 32 26.6	8 39.2	28	114
+ 40 00	+ 0 29.1	- 1 07.9	- 2 43.6	5 35 17.5	5 34 34.4	5 33 57.4	8 44.8	29	114
+ 41 00	+ 0 15.0	- 1 21.6	- 2 56.9	5 36 55.8	5 36 11.5	5 35 33.2	8 50.5	31	114
+ 42 00	+ 0 01.7	- 1 34.5	- 3 09.5	5 38 39.7	5 37 54.0	5 37 14.2	8 56.4	32	114
+ 43 00	- 0 10.8	- 1 46.6	- 3 21.2	5 40 29.4	5 39 42.1	5 39 00.6	9 02.4	34	114
+ 44 00	- 0 22.3	- 1 57.8	- 3 32.0	5 42 25.2	5 41 35.9	5 40 52.5	9 08.5	35	115
+ 45 00	- 0 32.9	- 2 08.0	- 3 41.9	5 44 27.1	5 43 35.6	5 42 50.0	9 14.8	36	115
+ 46 00	- 0 42.5	- 2 17.3	- 3 50.8	5 46 35.3	5 45 41.3	5 44 53.2	9 21.1	38	115
+ 47 00	- 0 50.9	- 2 25.4	- 3 58.7	5 48 50.0	5 47 53.2	5 47 02.3	9 27.6	39	116
+ 48 00	- 0 58.3	- 2 32.5	- 4 05.5	5 51 11.4	5 50 11.4	5 49 17.3	9 34.2	41	116
+ 49 00	- 1 04.4	- 2 38.4	- 4 11.2	5 53 39.6	5 52 36.1	5 51 38.5	9 40.8	42	117
+ 50 00	- 1 09.2	- 2 43.1	- 4 15.6	5 56 14.7	5 55 07.4	5 54 06.0	9 47.4	44	117
+ 51 00	- 1 12.7	- 2 46.4	- 4 18.8	5 58 57.0	5 57 45.4	5 56 39.9	9 54.1	45	118
+ 52 00	- 1 14.7	- 2 48.4	- 4 20.7	6 01 46.6	6 00 30.3	5 59 20.2	10 00.7	47	118
+ 53 00	- 1 15.3	- 2 48.9	- 4 21.1	6 04 43.5	6 03 22.2	6 02 07.2	10 07.3	48	119
+ 54 00	- 1 14.2	- 2 47.8	- 4 20.1	6 07 48.0	6 06 21.3	6 05 00.9	10 13.8	50	120
+ 55 00	- 1 11.4	- 2 45.2	- 4 17.5	6 11 00.1	6 09 27.5	6 08 01.5	10 20.1	51	121
+ 56 00	- 1 06.9	- 2 40.8	- 4 13.3	6 14 19.9	6 12 41.1	6 11 09.0	10 26.3	53	122
+ 57 00	- 1 00.5	- 2 34.7	- 4 07.4	6 17 47.5	6 16 02.1	6 14 23.5	10 32.2	54	124
+ 58 00	- 0 52.2	- 2 26.7	- 3 59.6	6 21 22.9	6 19 30.4	6 17 45.0	10 37.8	56	125
+ 59 00	- 0 41.8	- 2 16.7	- 3 50.1	6 25 05.9	6 23 06.2	6 21 13.6	10 43.1	57	127
+ 60 00	- 0 29.2	- 2 04.7	- 3 38.5	6 28 56.7	6 26 49.3	6 24 49.3	10 47.9	59	129
+ 61 00	- 0 14.5	- 1 50.6	- 3 24.9	6 32 55.0	6 30 39.8	6 28 32.0	10 52.3	60	132
+ 62 00	+ 0 02.6	- 1 34.2	- 3 09.3	6 37 00.5	6 34 37.3	6 32 21.6	10 56.0	61	134
+ 63 00	+ 0 22.0	- 1 15.6	- 2 51.4	6 41 13.0	6 38 41.7	6 36 18.0	10 59.2	62	137
+ 64 00	+ 0 43.9	- 0 54.6	- 2 31.3	6 45 32.1	6 42 52.8	6 40 21.0	11 01.6	63	141
+ 65 00	+ 1 08.3	- 0 31.3	- 2 08.8	6 49 57.3	6 47 10.1	6 44 30.3	11 03.3	64	145
+ 66 00	+ 1 35.2	- 0 05.5	- 1 44.1	6 54 27.9	6 51 33.1	6 48 45.5	11 04.3	65	149
+ 67 00	+ 2 04.7	+ 0 22.8	- 1 16.9	6 59 03.2	6 56 01.3	6 53 06.2	11 04.4	66	153
+ 68 00	+ 2 36.7	+ 0 53.6	- 0 47.3	7 03 42.4	7 00 34.0	6 57 31.8	11 03.7	66	158
+ 69 00	+ 3 11.2	+ 1 26.8	- 0 15.3	7 08 24.5	7 05 10.2	7 02 01.6	11 02.1	66	163

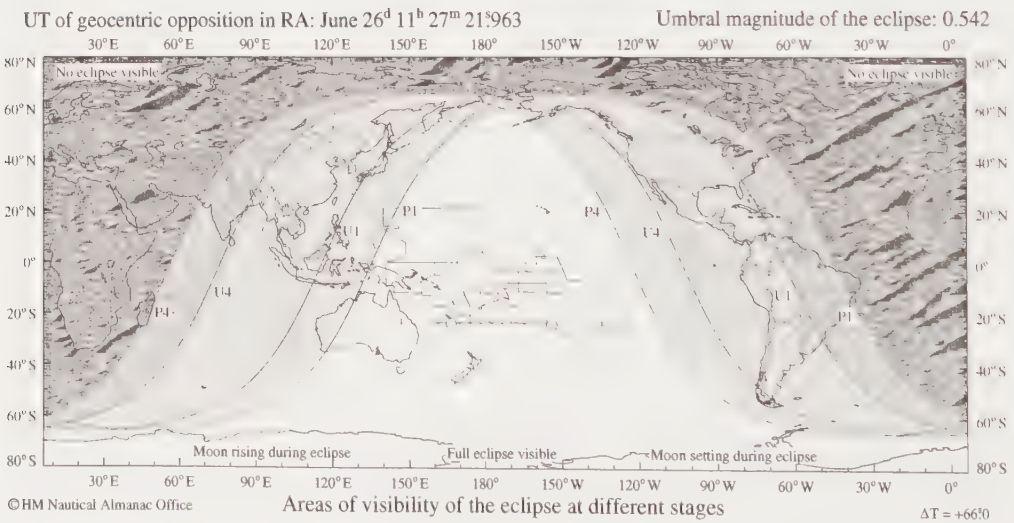
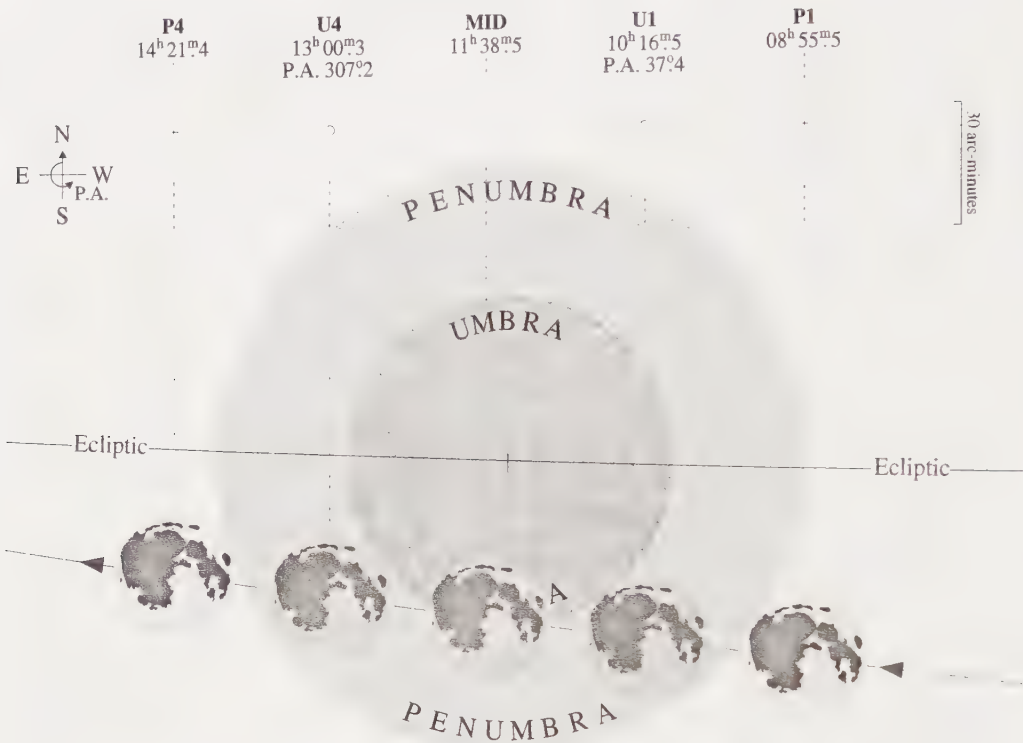
PATH OF CENTRAL PHASE: ANNULAR SOLAR ECLIPSE OF JANUARY 15

Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Sun's Az.
$^{\circ}$ $'$	$^{\circ}$ $'$	$^{\circ}$ $'$	$^{\circ}$ $'$	h m s	h m s	h m s	m s	$^{\circ}$	$^{\circ}$
+ 70 00	+ 3 48.1	+ 2 02.5	+ 0 19.0	7 13 08.4	7 09 49.2	7 06 34.8	10 59.8	66	169
+ 71 00	+ 4 27.5	+ 2 40.4	+ 0 55.7	7 17 53.0	7 14 29.9	7 11 10.6	10 56.6	66	174
+ 72 00	+ 5 09.0	+ 3 20.7	+ 1 34.6	7 22 37.1	7 19 11.1	7 15 48.0	10 52.7	66	179
+ 73 00	+ 5 52.6	+ 4 03.0	+ 2 15.6	7 27 19.3	7 23 51.7	7 20 25.9	10 48.2	65	184
+ 74 00	+ 6 38.1	+ 4 47.2	+ 2 58.6	7 31 58.5	7 28 30.6	7 25 03.1	10 43.0	64	188
+ 75 00	+ 7 25.2	+ 5 33.3	+ 3 43.5	7 36 33.4	7 33 06.4	7 29 38.5	10 37.3	63	192
+ 76 00	+ 8 13.8	+ 6 20.8	+ 4 30.0	7 41 02.8	7 37 37.9	7 34 11.0	10 31.2	61	196
+ 77 00	+ 9 03.7	+ 7 09.7	+ 5 17.9	7 45 25.7	7 42 04.2	7 38 39.3	10 24.7	60	199
+ 78 00	+ 9 54.5	+ 7 59.7	+ 6 07.0	7 49 41.1	7 46 24.0	7 43 02.3	10 18.0	58	202
+ 79 00	+10 46.0	+ 8 50.6	+ 6 57.1	7 53 48.2	7 50 36.6	7 47 19.2	10 11.1	57	205
+ 80 00	+11 38.1	+ 9 42.1	+ 7 48.0	7 57 46.4	7 54 41.0	7 51 28.9	10 04.0	55	207
+ 81 00	+12 30.5	+10 34.1	+ 8 39.4	8 01 35.1	7 58 36.8	7 55 30.7	9 56.9	54	210
+ 82 00	+13 23.0	+11 26.2	+ 9 31.2	8 05 14.1	8 02 23.3	7 59 24.0	9 49.8	52	212
+ 83 00	+14 15.4	+12 18.4	+10 23.1	8 08 42.9	8 06 00.2	8 03 08.3	9 42.8	50	213
+ 84 00	+15 07.6	+13 10.5	+11 14.9	8 12 01.7	8 09 27.4	8 06 43.3	9 35.9	48	215
+ 85 00	+15 59.4	+14 02.2	+12 06.6	8 15 10.3	8 12 44.6	8 10 08.7	9 29.1	47	216
+ 86 00	+16 50.7	+14 53.5	+12 57.9	8 18 08.9	8 15 51.9	8 13 24.4	9 22.4	45	218
+ 87 00	+17 41.4	+15 44.3	+13 48.7	8 20 57.7	8 18 49.5	8 16 30.4	9 16.0	43	219
+ 88 00	+18 31.4	+16 34.5	+14 38.9	8 23 36.9	8 21 37.4	8 19 26.8	9 09.7	42	220
+ 89 00	+19 20.7	+17 23.9	+15 28.5	8 26 06.8	8 24 15.8	8 22 13.7	9 03.6	40	221
+ 90 00	+20 09.3	+18 12.6	+16 17.4	8 28 27.6	8 26 45.2	8 24 51.4	8 57.7	38	222
+ 91 00	+20 56.9	+19 00.5	+17 05.4	8 30 39.8	8 29 05.7	8 27 20.2	8 52.0	37	223
+ 92 00	+21 43.7	+19 47.5	+17 52.6	8 32 43.7	8 31 17.7	8 29 40.2	8 46.5	35	224
+ 93 00	+22 29.7	+20 33.7	+18 39.0	8 34 39.7	8 33 21.5	8 31 51.9	8 41.2	34	225
+ 94 00	+23 14.7	+21 18.9	+19 24.5	8 36 28.0	8 35 17.4	8 33 55.6	8 36.1	32	226
+ 95 00	+23 58.8	+22 03.3	+20 09.1	8 38 09.1	8 37 05.9	8 35 51.5	8 31.1	31	226
+ 96 00	+24 42.1	+22 46.7	+20 52.8	8 39 43.4	8 38 47.3	8 37 40.0	8 26.4	29	227
+ 97 00	+25 24.4	+23 29.3	+21 35.5	8 41 11.0	8 40 21.8	8 39 21.5	8 21.8	28	228
+ 98 00	+26 05.8	+24 10.9	+22 17.4	8 42 32.5	8 41 49.9	8 40 56.3	8 17.4	26	229
+ 99 00	+26 46.3	+24 51.7	+22 58.4	8 43 48.1	8 43 11.8	8 42 24.6	8 13.2	25	229
+100 00	+27 26.0	+25 31.5	+23 38.4	8 44 58.0	8 44 27.9	8 43 46.9	8 09.1	24	230
+101 00	+28 04.8	+26 10.5	+24 17.6	8 46 02.6	8 45 38.4	8 45 03.4	8 05.2	22	231
+102 00	+28 42.8	+26 48.7	+24 56.0	8 47 02.2	8 46 43.6	8 46 14.3	8 01.4	21	231
+103 00	+29 19.9	+27 26.0	+25 33.4	8 47 57.0	8 47 43.8	8 47 20.0	7 57.7	20	232
+104 00	+29 56.3	+28 02.4	+26 10.1	8 48 47.2	8 48 39.3	8 48 20.7	7 54.2	18	233
+105 00	+30 31.8	+28 38.1	+26 45.9	8 49 33.2	8 49 30.2	8 49 16.7	7 50.8	17	233
+106 00	+31 06.5	+29 13.0	+27 20.9	8 50 15.0	8 50 16.8	8 50 08.2	7 47.5	16	234
+107 00	+31 40.5	+29 47.1	+27 55.2	8 50 52.9	8 50 59.3	8 50 55.4	7 44.4	15	234
+108 00	+32 13.8	+30 20.4	+28 28.6	8 51 27.2	8 51 38.0	8 51 38.5	7 41.3	14	235
+109 00	+32 46.3	+30 53.0	+29 01.3	8 51 57.9	8 52 12.9	8 52 17.7	7 38.4	13	236
+110 00	+33 18.1	+31 24.9	+29 33.3	8 52 25.3	8 52 44.4	8 52 53.3	7 35.5	12	236
+111 00	+33 49.2	+31 56.1	+30 04.6	8 52 49.6	8 53 12.5	8 53 25.4	7 32.7	10	237
+112 00	+34 19.6	+32 26.6	+30 35.2	8 53 10.9	8 53 37.5	8 53 54.1	7 30.1	9	237
+113 00	+34 49.4	+32 56.4	+31 05.1	8 53 29.2	8 53 59.4	8 54 19.6	7 27.5	8	238
+114 00	+35 18.1	+33 25.6	+31 34.3	8 53 43.4	8 54 18.6	8 54 42.2	7 25.0	7	239
+115 00	+35 46.8	+33 53.9	+32 02.9	8 53 57.4	8 54 33.9	8 55 01.8	7 22.6	6	239

For limits, see Circumstances of the Eclipse

II. - Partial Eclipse of the Moon

2010 June 26



III. –Total Eclipse of the Sun, 2010 July 11

CIRCUMSTANCES OF THE ECLIPSE

UT of geocentric conjunction in right ascension, July 11^d 19^h 50^m 54^s.698

Julian Date = 2455389.3270219620

		UT	Longitude	Latitude
		d h m	° ′	° ′
Eclipse begins	July	11 17 09.6	–161 13.7	–11 39.0
Beginning of northern limit of umbra		11 18 15.9	–171 10.8	–26 02.2
Beginning of center line; central eclipse begins		11 18 16.8	–170 59.3	–26 51.6
Beginning of southern limit of umbra		11 18 17.8	–170 47.8	–27 41.8
Central eclipse at local apparent noon		11 19 50.9	–116 20.5	–22 28.0
End of southern limit of umbra		11 20 49.0	– 71 34.5	–51 36.6
End center line; central eclipse ends		11 20 50.0	– 70 55.8	–50 51.6
End of northern limit of umbra		11 20 51.0	– 70 19.0	–50 07.0
Eclipse ends		11 21 57.2	– 75 31.8	–36 47.4

BESSELIAN ELEMENTS

Let $t = (\text{UT} - 17^{\text{h}}) + \delta T / 3600$ in units of hours.

These equations are valid over the range $0^{\text{h}}.042 \leq t \leq 5^{\text{h}}.125$. Do not use t outside the given range, and do not omit any terms in the series.

Intersection of axis of shadow with fundamental plane:

$$x = -1.58735374 + 0.55717691 t + 0.00005274 t^2 - 0.00000899 t^3$$

$$y = -0.31070295 - 0.13592638 t - 0.00013323 t^2 + 0.00000236 t^3$$

Direction of axis of shadow:

$$\sin d = +0.37544119 - 0.00008592 t - 0.00000007 t^2$$

$$\cos d = +0.92684624 + 0.00003476 t + 0.00000005 t^2$$

$$\mu = 73^{\circ}.61337258 + 15.00005878 t + 0.00000192 t^2 - 0.00000004 t^3 - 0.00417807 \delta T$$

Radius of shadow on fundamental plane:

$$\text{penumbra } (l_1) = +0.53460606 - 0.00001711 t - 0.00001236 t^2$$

$$\text{umbra } (l_2) = -0.01172074 - 0.00001703 t - 0.00001228 t^2$$

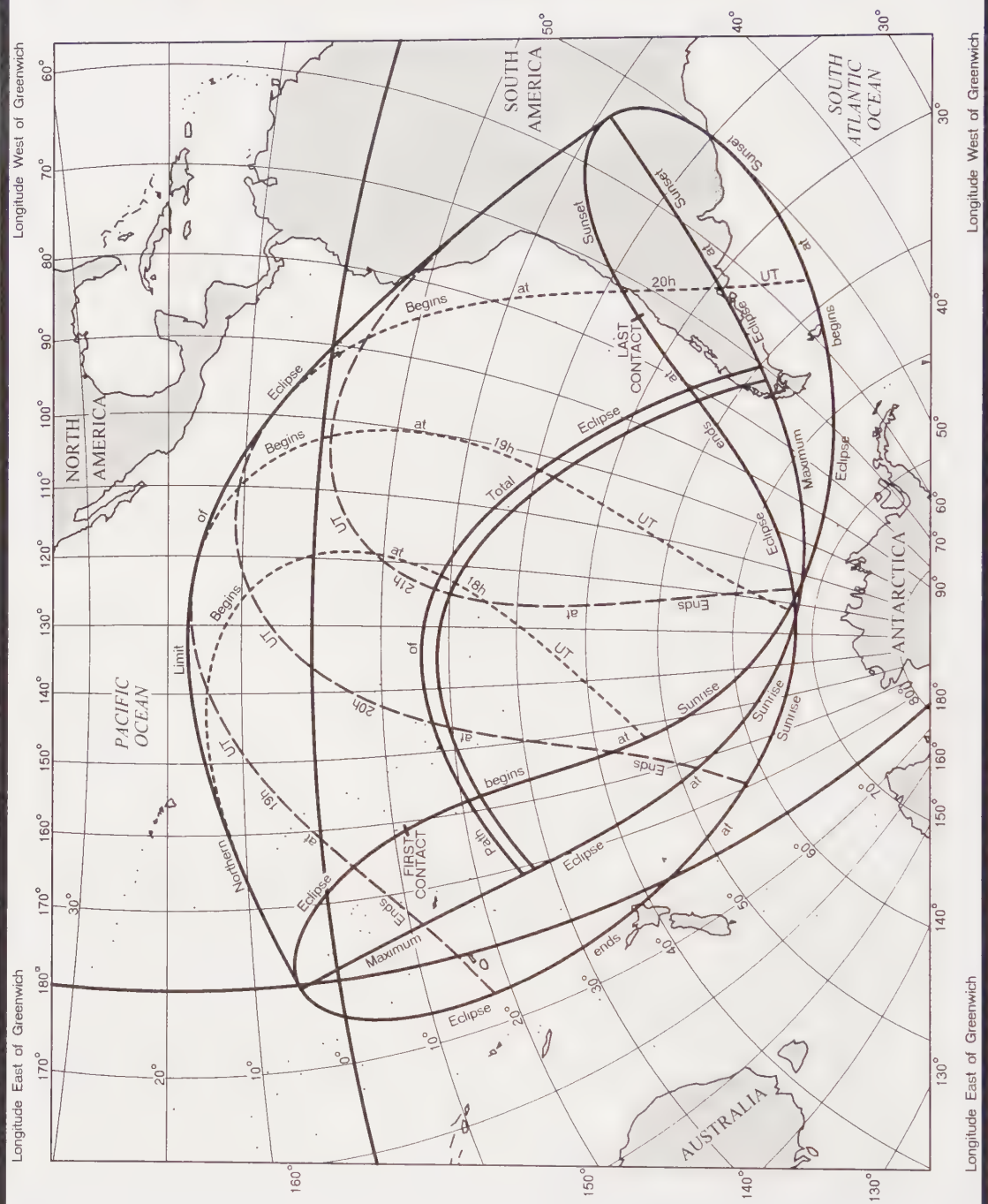
$$\tan f_1 = +0.004599$$

$$\tan f_2 = +0.004576$$

$$\mu' = +0.261801 \text{ radians per hour}$$

$$d' = -0.000093 \text{ radians per hour}$$

TOTAL SOLAR ECLIPSE OF 2010 JULY 11



PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF JULY 11

For limits, see Circumstances of the Eclipse

Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Sun's Az.
$^{\circ}$ $'$	$^{\circ}$ $'$	$^{\circ}$ $'$	$^{\circ}$ $'$	$^{\text{h}}$ $^{\text{m}}$ $^{\text{s}}$	$^{\text{h}}$ $^{\text{m}}$ $^{\text{s}}$	$^{\text{h}}$ $^{\text{m}}$ $^{\text{s}}$	$^{\text{m}}$ $^{\text{s}}$	$^{\circ}$	$^{\circ}$
-168 00	-24 42.9	-25 38.0	-26 33.7	18 16 08.6	18 17 02.9	18 18 01.4	2 53.2	3	64
-167 00	-24 18.4	-25 13.9	-26 10.0	18 16 18.4	18 17 14.0	18 18 12.7	2 55.9	4	63
-166 00	-23 53.9	-24 49.8	-25 46.2	18 16 28.3	18 17 25.0	18 18 24.1	2 58.7	5	63
-165 00	-23 29.7	-24 25.9	-25 22.6	18 16 42.1	18 17 38.3	18 18 37.3	3 01.5	6	62
-164 00	-23 06.0	-24 02.4	-24 59.5	18 17 00.8	18 17 56.7	18 18 55.5	3 04.4	7	62
-163 00	-22 42.5	-23 39.3	-24 36.7	18 17 22.0	18 18 18.0	18 19 16.9	3 07.4	8	62
-162 00	-22 19.3	-23 16.4	-24 14.2	18 17 46.6	18 18 42.5	18 19 41.5	3 10.4	9	61
-161 00	-21 56.5	-22 53.9	-23 52.1	18 18 14.4	18 19 10.3	18 20 09.4	3 13.6	10	61
-160 00	-21 34.0	-22 31.8	-23 30.3	18 18 45.5	18 19 41.5	18 20 40.6	3 16.8	11	60
-159 00	-21 11.9	-22 10.1	-23 09.0	18 19 20.2	18 20 16.2	18 21 15.4	3 20.1	13	60
-158 00	-20 50.3	-21 48.8	-22 48.1	18 19 58.4	18 20 54.5	18 21 53.8	3 23.5	14	59
-157 00	-20 29.1	-21 28.0	-22 27.6	18 20 40.3	18 21 36.5	18 22 35.8	3 27.0	15	59
-156 00	-20 08.4	-21 07.7	-22 07.7	18 21 25.9	18 22 22.2	18 23 21.7	3 30.6	16	58
-155 00	-19 48.2	-20 47.9	-21 48.2	18 22 15.5	18 23 11.9	18 24 11.5	3 34.2	17	58
-154 00	-19 28.5	-20 28.6	-21 29.4	18 23 08.9	18 24 05.5	18 25 05.4	3 37.9	18	57
-153 00	-19 09.5	-20 09.9	-21 11.1	18 24 06.5	18 25 03.2	18 26 03.3	3 41.7	19	56
-152 00	-18 51.0	-19 51.9	-20 53.5	18 25 08.1	18 26 05.1	18 27 05.5	3 45.6	20	56
-151 00	-18 33.2	-19 34.5	-20 36.5	18 26 14.1	18 27 11.3	18 28 11.9	3 49.6	22	55
-150 00	-18 16.1	-19 17.8	-20 20.2	18 27 24.3	18 28 21.9	18 29 22.8	3 53.6	23	55
-149 00	-17 59.7	-19 01.9	-20 04.7	18 28 39.0	18 29 36.9	18 30 38.2	3 57.7	24	54
-148 00	-17 44.1	-18 46.7	-19 50.0	18 29 58.2	18 30 56.5	18 31 58.2	4 01.9	25	53
-147 00	-17 29.4	-18 32.4	-19 36.1	18 31 22.0	18 32 20.8	18 33 22.9	4 06.1	26	53
-146 00	-17 15.5	-18 18.9	-19 23.2	18 32 50.5	18 33 49.8	18 34 52.4	4 10.3	27	52
-145 00	-17 02.5	-18 06.4	-19 11.1	18 34 23.8	18 35 23.6	18 36 26.8	4 14.6	29	51
-144 00	-16 50.5	-17 54.9	-19 00.1	18 36 01.8	18 37 02.3	18 38 06.1	4 19.0	30	50
-143 00	-16 39.5	-17 44.4	-18 50.1	18 37 44.8	18 38 45.9	18 39 50.4	4 23.3	31	49
-142 00	-16 29.6	-17 35.0	-18 41.2	18 39 32.8	18 40 34.6	18 41 39.7	4 27.7	32	49
-141 00	-16 20.9	-17 26.7	-18 33.4	18 41 25.7	18 42 28.3	18 43 34.2	4 32.1	33	48
-140 00	-16 13.3	-17 19.7	-18 26.9	18 43 23.7	18 44 27.1	18 45 33.8	4 36.4	34	46
-139 00	-16 07.0	-17 13.9	-18 21.6	18 45 26.7	18 46 31.0	18 47 38.6	4 40.7	35	45
-138 00	-16 02.0	-17 09.4	-18 17.7	18 47 34.8	18 48 40.1	18 49 48.6	4 45.0	36	44
-137 00	-15 58.3	-17 06.3	-18 15.2	18 49 47.9	18 50 54.2	18 52 03.7	4 49.1	38	43
-136 00	-15 56.1	-17 04.6	-18 14.1	18 52 06.1	18 53 13.4	18 54 23.9	4 53.2	39	42
-135 00	-15 55.4	-17 04.5	-18 14.5	18 54 29.3	18 55 37.7	18 56 49.1	4 57.2	40	40
-134 00	-15 56.2	-17 05.9	-18 16.6	18 56 57.3	18 58 06.9	18 59 19.3	5 01.0	41	39
-133 00	-15 58.7	-17 08.9	-18 20.2	18 59 30.2	19 00 40.9	19 01 54.3	5 04.6	41	37
-132 00	-16 02.8	-17 13.7	-18 25.6	19 02 07.8	19 03 19.6	19 04 34.0	5 08.0	42	35
-131 00	-16 08.6	-17 20.1	-18 32.6	19 04 50.0	19 06 02.8	19 07 18.1	5 11.2	43	34
-130 00	-16 16.2	-17 28.3	-18 41.5	19 07 36.4	19 08 50.3	19 10 06.5	5 14.1	44	32
-129 00	-16 25.6	-17 38.4	-18 52.2	19 10 27.0	19 11 41.9	19 12 58.8	5 16.7	45	30
-128 00	-16 36.9	-17 50.3	-19 04.8	19 13 21.5	19 14 37.2	19 15 54.8	5 19.0	45	28
-127 00	-16 50.1	-18 04.1	-19 19.2	19 16 19.5	19 17 36.0	19 18 54.0	5 21.0	46	26
-126 00	-17 05.2	-18 19.8	-19 35.6	19 19 20.8	19 20 37.8	19 21 56.2	5 22.6	46	23
-125 00	-17 22.2	-18 37.5	-19 53.8	19 22 24.8	19 23 42.3	19 25 00.8	5 23.8	47	21
-124 00	-17 41.2	-18 57.1	-20 14.0	19 25 31.3	19 26 49.0	19 28 07.4	5 24.6	47	19
-123 00	-18 02.1	-19 18.6	-20 36.1	19 28 39.8	19 29 57.4	19 31 15.4	5 25.0	47	16
-122 00	-18 25.0	-19 42.0	-21 00.1	19 31 49.6	19 33 07.0	19 34 24.4	5 25.0	47	14
-121 00	-18 49.7	-20 07.3	-21 25.9	19 35 00.4	19 36 17.2	19 37 33.6	5 24.6	47	11
-120 00	-19 16.3	-20 34.4	-21 53.5	19 38 11.6	19 39 27.5	19 40 42.6	5 23.7	47	9
-119 00	-19 44.7	-21 03.3	-22 22.8	19 41 22.6	19 42 37.3	19 43 50.8	5 22.4	47	6

PATH OF CENTRAL PHASE: TOTAL SOLAR ECLIPSE OF JULY 11

Longitude	Latitude of:			Universal Time at:			On Central Line		
	Northern Limit	Central Line	Southern Limit	Northern Limit	Central Line	Southern Limit	Maximum Duration	Sun's Alt.	Az.
° ′	° ′	° ′	° ′	h m s	h m s	h m s	m s	°	°
-118 00	-20 14.9	-21 33.8	-22 53.7	19 44 32.8	19 45 45.9	19 46 57.5	5 20.8	46	4
-117 00	-20 46.7	-22 06.0	-23 26.2	19 47 41.7	19 48 52.9	19 50 02.3	5 18.8	46	2
-116 00	-21 20.1	-22 39.7	-24 00.2	19 50 48.6	19 51 57.6	19 53 04.4	5 16.4	45	359
-115 00	-21 54.9	-23 14.7	-24 35.5	19 53 53.0	19 54 59.4	19 56 03.4	5 13.7	45	357
-114 00	-22 31.1	-23 51.1	-25 12.0	19 56 54.3	19 57 57.9	19 58 58.7	5 10.7	44	355
-113 00	-23 08.5	-24 28.7	-25 49.6	19 59 52.1	20 00 52.6	20 01 50.0	5 07.5	43	353
-112 00	-23 47.1	-25 07.3	-26 28.2	20 02 45.9	20 03 43.0	20 04 36.8	5 04.0	42	351
-111 00	-24 26.7	-25 46.8	-27 07.7	20 05 35.2	20 06 28.8	20 07 18.8	5 00.3	41	349
-110 00	-25 07.1	-26 27.2	-27 48.0	20 08 19.7	20 09 09.5	20 09 55.6	4 56.4	40	347
-109 00	-25 48.3	-27 08.2	-28 28.8	20 10 59.1	20 11 44.9	20 12 26.9	4 52.4	39	345
-108 00	-26 30.1	-27 49.8	-29 10.2	20 13 33.0	20 14 14.9	20 14 52.7	4 48.3	38	343
-107 00	-27 12.4	-28 31.9	-29 52.0	20 16 01.4	20 16 39.1	20 17 12.6	4 44.2	37	342
-106 00	-27 55.1	-29 14.3	-30 34.1	20 18 23.9	20 18 57.5	20 19 26.7	4 39.9	36	340
-105 00	-28 38.1	-29 56.9	-31 16.4	20 20 40.6	20 21 09.9	20 21 34.9	4 35.7	35	339
-104 00	-29 21.3	-30 39.8	-31 58.8	20 22 51.3	20 23 16.4	20 23 37.2	4 31.4	34	337
-103 00	-30 04.6	-31 22.6	-32 41.3	20 24 56.0	20 25 16.9	20 25 33.5	4 27.1	33	336
-102 00	-30 47.9	-32 05.5	-33 23.7	20 26 54.7	20 27 11.5	20 27 24.0	4 22.9	31	334
-101 00	-31 31.1	-32 48.3	-34 06.0	20 28 47.5	20 29 00.2	20 29 08.7	4 18.7	30	333
-100 00	-32 14.2	-33 30.9	-34 48.1	20 30 34.4	20 30 43.2	20 30 47.7	4 14.5	29	332
- 99 00	-32 57.1	-34 13.3	-35 30.0	20 32 15.5	20 32 20.5	20 32 21.1	4 10.4	28	331
- 98 00	-33 39.8	-34 55.4	-36 11.6	20 33 51.0	20 33 52.2	20 33 49.1	4 06.4	27	330
- 97 00	-34 22.1	-35 37.2	-36 52.9	20 35 21.0	20 35 18.6	20 35 11.8	4 02.4	26	329
- 96 00	-35 04.1	-36 18.6	-37 33.8	20 36 45.7	20 36 39.7	20 36 29.4	3 58.6	24	328
- 95 00	-35 45.7	-36 59.7	-38 14.3	20 38 05.1	20 37 55.7	20 37 42.1	3 54.8	23	327
- 94 00	-36 26.9	-37 40.3	-38 54.4	20 39 19.5	20 39 06.8	20 38 50.0	3 51.0	22	326
- 93 00	-37 07.6	-38 20.5	-39 34.0	20 40 29.0	20 40 13.2	20 39 53.3	3 47.4	21	325
- 92 00	-37 47.9	-39 00.2	-40 13.2	20 41 33.9	20 41 15.0	20 40 52.1	3 43.9	20	324
- 91 00	-38 27.7	-39 39.4	-40 51.9	20 42 34.2	20 42 12.4	20 41 46.7	3 40.4	19	323
- 90 00	-39 06.9	-40 18.1	-41 30.0	20 43 30.2	20 43 05.7	20 42 37.2	3 37.1	18	322
- 89 00	-39 45.6	-40 56.3	-42 07.7	20 44 22.0	20 43 54.8	20 43 23.8	3 33.8	17	321
- 88 00	-40 23.8	-41 34.0	-42 44.8	20 45 09.8	20 44 40.1	20 44 06.6	3 30.6	16	320
- 87 00	-41 01.5	-42 11.1	-43 21.4	20 45 53.8	20 45 21.7	20 44 45.9	3 27.5	15	319
- 86 00	-41 38.5	-42 47.6	-43 57.4	20 46 34.2	20 45 59.8	20 45 21.7	3 24.5	14	318
- 85 00	-42 15.1	-43 23.6	-44 32.9	20 47 11.0	20 46 34.4	20 45 54.2	3 21.6	13	318
- 84 00	-42 51.0	-43 59.1	-45 07.9	20 47 44.5	20 47 05.9	20 46 23.6	3 18.8	12	317
- 83 00	-43 26.4	-44 34.0	-45 42.3	20 48 14.8	20 47 34.2	20 46 50.1	3 16.0	11	316
- 82 00	-44 01.3	-45 08.3	-46 16.1	20 48 42.0	20 47 59.6	20 47 13.7	3 13.4	10	315
- 81 00	-44 35.5	-45 42.1	-46 49.4	20 49 06.4	20 48 22.2	20 47 34.5	3 10.8	9	314
- 80 00	-45 09.2	-46 15.3	-47 22.2	20 49 27.9	20 48 42.2	20 47 52.8	3 08.2	8	314
- 79 00	-45 42.4	-46 48.0	-47 54.1	20 49 47.0	20 48 59.4	20 48 07.5	3 05.8	7	313
- 78 00	-46 14.8	-47 19.7	-48 25.7	20 50 02.8	20 49 12.9	20 48 20.8	3 03.5	6	312

For limits, see Circumstances of the Eclipse

Joint publications of HM Nautical Almanac Office (UKHO) and the United States Naval Observatory

These publications are published by and available from, UKHO Distributors, and the Superintendent of Documents, U.S. Government Printing Office (USGPO) except where noted.

The Astronomical Almanac contains ephemerides of the Sun, Moon, planets and their natural satellites, as well as data on eclipses and other astronomical phenomena. The data in this annual volume are calculated cooperatively by the British and American offices, with contributions from the Bureau des Longitudes, Astronomisches Rechen-Institut, the Institute of Theoretical Astronomy, St. Petersburg, and B.G. Marsden, Smithsonian Astrophysical Observatory.

The Nautical Almanac contains ephemerides at an interval of one hour and auxiliary astronomical data for marine navigation.

The Air Almanac contains ephemerides at an interval of ten minutes and auxiliary astronomical data for air navigation. This publication is now distributed solely on CD-ROM and is only available from USGPO.

Other publications of HM Nautical Almanac Office (UKHO)

The Star Almanac for Land Surveyors (NP 321) contains the Greenwich hour angle of Aries and the position of the Sun, tabulated for every six hours, and represented by monthly polynomial coefficients. Positions of all stars brighter than magnitude 4.0 are tabulated monthly to a precision of 0.1 in right ascension and 1" in declination. A CD-ROM accompanies this book which contains the electronic edition plus coefficients, in ASCII format, representing the data.

NavPac and Compact Data for 2006–2010 contains software, algorithms and data, which are mainly in the form of polynomial coefficients, for calculating the positions of the Sun, Moon, navigational planets and bright stars. It enables navigators to compute their position at sea from sextant observations using an IBM PC or compatible for the period 1986–2010. The tabular data are also supplied as ASCII files on the CD-ROM.

Planetary and Lunar Coordinates, 2001–2020 provides low-precision astronomical data and phenomena for use well in advance of the annual ephemerides. It contains heliocentric, geocentric, spherical and rectangular coordinates of the Sun, Moon and planets, eclipse maps and auxiliary data. All the tabular ephemerides are supplied solely on CD-ROM as ASCII and Adobe's portable document format files. The full printed edition is published in the United States by Willmann-Bell Inc, PO Box 35025, Richmond VA 23235, USA.

Rapid Sight Reduction Tables for Navigation (AP3270 / NP 303), 3 volumes, formerly entitled *Sight Reduction Tables for Air Navigation*. Volume 1, selected stars for epoch 2005.0, containing the altitude to 1' and true azimuth to 1° for the seven stars most suitable for navigation, for all latitudes and hour angles of Aries. Volumes 2 and 3 contain altitudes to 1' and azimuths to 1° for integral degrees of declination from N 29° to S 29°, for relevant latitudes and all hour angles at which the zenith distance is less than 95° providing for sights of the Sun, Moon and planets.

Sight Reduction Tables for Marine Navigation (NP 401), 6 volumes. This series is designed to effect all solutions of the navigational triangle and is intended for use with *The Nautical Almanac*.

The UK Air Almanac contains data useful in the planning of activities where the level of illumination is important, particularly aircraft movements, and is produced to the general requirements of the Royal Air Force.

NAO Technical Notes are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

Other publications of the United States Naval Observatory

Astronomical Papers of the American Ephemeris[†] are issued irregularly and contain reports of research in celestial mechanics with particular relevance to ephemerides.

U.S. Naval Observatory Circulars[†] are issued irregularly to disseminate astronomical data concerning ephemerides or astronomical phenomena.

U.S. Naval Observatory Circular No. 179, The IAU Resolutions on Astronomical Reference Systems, Time Scales, and Earth Rotation Models explains resolutions and their effects on the data, and available at http://aa.usno.navy.mil/publications/docs/Circular_179.php.

Explanatory Supplement to The Astronomical Almanac edited by P. Kenneth Seidelmann of the U.S. Naval Observatory. This book is an authoritative source on the basis and derivation of information contained in *The Astronomical Almanac*, and it contains material that is relevant to positional and dynamical astronomy and to chronology. It includes details of the FK5 J2000.0 reference system and transformations. The publication is a collaborative work with authors from the U.S. Naval Observatory, H.M. Nautical Almanac Office, the Jet Propulsion Laboratory and the Bureau des Longitudes. It is published by, and available from, University Science Books, 55D Gate Five Road, Sausalito, CA 94965, whose UK distributor is Macmillan.

MICA is an interactive astronomical almanac for professional applications. Software for both PC systems with Intel processors and Apple Macintosh computers is provided on a single CD-ROM. *MICA* allows a user to compute, to full precision, much of the tabular data contained in *The Astronomical Almanac*, as well as data for specific times and locations. All calculations are made in real time and data are not interpolated from tables. *MICA* is published by, and available from, Willmann-Bell Inc. The latest version covers the interval 1800-2050.

† Many of these publications are available from the Nautical Almanac Office, U.S. Naval Observatory, Washington, DC 20392-5420, see <http://aa.usno.navy.mil/> for availability.

Publications of other countries

Apparent Places of Fundamental Stars is prepared by the Astronomisches Rechen-Institut, Heidelberg (www.ari.uni-heidelberg.de). The printed version of APFS gives the data for a few fundamental stars only, together with the explanation and examples. The apparent places of stars using the FK6 or Hipparcos catalogues are provided by the on-line database ARIAPFS (www.ari.uni-heidelberg.de/ariapfs). The printed booklet also contains the so-called '10-Day-Stars' and the 'Circumpolar Stars' and is available from Verlag G. Braun, Karl-Friedrich-Strasse, 14-18, Karlsruhe, Germany.

Ephemerides of Minor Planets is prepared annually by the Institute of Applied Astronomy (www.ipa.nw.ru), and published by the Russian Academy of Sciences. Included in this volume are elements, opposition dates and opposition ephemerides of all numbered minor planets. This volume is available from the Institute of Theoretical Astronomy, Naberezhnaya Kutuzova 10, 191187 St. Petersburg, Russia.

Electronic Publications

The Astronomical Almanac Online (AsA Online): The companion publication of *The Astronomical Almanac* is available at

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